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**Course Keeping Stability Model Tests
of a USCG Notional Design
of a 120 FT WPB Hull**

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16. Abstract Directional stability tests were performed on a 1/18 scale model of the hull of a 120 ft WPB notional design. Captive model tests were performed to add to a data base of basic hydrodynamic information about planing hulls. This information is required for the study of the dynamic stability, course keeping, maneuvering and control of planing hulls. Straight course and rotating arm tests, at two radii, were conducted at the Froude scale equivalent of 12.5 and 35 knots. The two radii correspond to dimensionless angular velocities, L/R, of 0.206 and 0.412. The model was free to trim. The three force components and two moment components, as well as heave and trim, were measured. The yaw angle was varied from -6 to +12 degrees, in either 3 or 6 degree increments. The roll angle was varied from -10 to +20 degrees, in 10 degree increments. Most of the tests were conducted at a displacement corresponding to 135 long tons full size. Rudders were added and the appended hull tested on straight course and at an L/R of 0.206. Straight course rudder effectiveness tests were performed at rudder angles of 0 to 15 degrees in 5 degree increments. A limited number of bare hull tests were conducted at a displacement of 155 long tons, and at an L/R of 0.206. Underwater photographs and video recordings were made of all runs both on straight course and on the rotating arm.			
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METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol When You Know Multiply By To Find Symbol

LENGTH

in	inches	* 2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km

AREA

in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.8	square meters	m ²
mi ²	square miles	2.6	square kilometers	km ²
	acres	0.4	hectares	ha

MASS (WEIGHT)

oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t

VOLUME

tsp	teaspoons	5	milliliters	ml
tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft ³	cubic feet	0.03	cubic meters	m ³
yd ³	cubic yards	0.76	cubic meters	m ³

TEMPERATURE (EXACT)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
----	------------------------	----------------------------	---------------------	----

*1 in = 2.54 (exactly).

Approximate Conversions from Metric Measures

Symbol When You Know Multiply By To Find Symbol

LENGTH

mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi

AREA

cm ²	square centimeters	0.16	square inches	in ²
m ²	square meters	1.2	square yards	yd ²
km ²	square kilometers	0.4	square miles	mi ²
ha	hectares (10,000 m ²)	2.5	acres	

MASS (WEIGHT)

g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	

VOLUME

ml	milliliters	0.03	fluid ounces	fl oz
l	liters	0.125	cups	c
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m ³	cubic meters	35	cubic feet	ft ³
m ³	cubic meters	1.3	cubic yards	yd ³

TEMPERATURE (EXACT)

°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F
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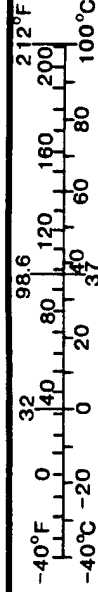


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NOMENCLATURE

b	maximum beam over upper chines, ft
CG	center of gravity
CM	center of moments, pivot point in free-to-trim tests
Cv	velocity coefficient, V/\sqrt{gb}
Fn_v	volume Froude Number, $V/\sqrt{g\nabla^{1/3}}$
g	acceleration due to gravity, 32.17 fps ²
K	roll moment, lb-ft, see Appendix C
M	pitch moment, lb-ft, see Appendix C
N	yaw moment, lb-ft, see Appendix C
L	LOA, length overall, ft
L/b	length-beam ratio
LBP	length between perpendiculars, ft
LCG	longitudinal position of the center of gravity (CG), measured from the aft perpendicular parallel to the baseline, ft
LCM	longitudinal position of the center of moments (CM), measured from the aft perpendicular parallel to the baseline, ft
LOA	length overall, ft
L/R	non-dimensional turn rate
q	dynamic pressure, $\frac{1}{2}\rho V^2$
R	radius of turn, ft
SKWL	static keel wetted length, ft, see page 12
TD	transom draft, depth of keel at transom below still water level, ft
V	velocity, fps
V _k	speed, knots
VCG	vertical height of the center of gravity above the baseline, ft
VCM	vertical height of the center of moments above the baseline, ft
w	specific weight of water, 62.28 lb/cu.ft fresh water at 71.5°F (test condition), 64.00 lb/cu.ft salt water at 59°F (standard condition).
X	longitudinal force, lb, see Appendix C
Y	lateral force, lb, see Appendix C
Z	vertical force, lb, see Appendix C
ϕ	roll angle, degrees, see Appendix C
θ	trim angle, degrees, see Appendix C

β	yaw angle, degrees, see Appendix C
ρ	density of water, w/g, slugs per cu.ft
Δ	displacement, lb
∇	volumetric displacement, Δ/w , cu.ft
Ω	rate of turn, radians per second

Non-dimensional quantities

Forces		Moments	
X'	X/qb^2	K'	K/qb^3
Y'	Y/qb^2	M'	M/qb^3
Z'	Z/qb^2	N'	N/qb^3

Sign Convention

The sign conventions are discussed in Appendix C and vary with the axes system being used. The sense of some quantities that in this report are invariant under the various transformations are summarized here.

The trim is positive in the bow up sense and is zero when the afterbody keel is horizontal. The baseline has a positive inclination of 0.76 degrees relative to the afterbody keel. Therefore when the trim is zero the trim of the baseline is 0.76 degrees.

The heave is the height of the tow point above the still water surface, is positive vertically upward, and is zero when the tow point is at the still water level. The towpoint is coincident with the center of moments (CM).

The transom draft (TD) is the depth of the keel at transom below the still water surface, is positive vertically downward, and is zero when the keel at transom is at the still water level.

The resultant velocity is a horizontal vector, positive forward in the stern-to-bow sense, and is zero when the boat is at rest.

EXECUTIVE SUMMARY

A number of undesirable stability and maneuvering characteristics have occurred on various boat designs, including Coast Guard boats, during the past twenty years. The 30 ft. SRB had a roll-pitch-yaw instability problem, and the prototype 47 ft MLB rolled excessively in a high speed turn. One of the basic reasons for problems of this nature is the lack of understanding of the hydrodynamics associated with high speed craft that are doing anything but traveling in a straight line. This report takes a step toward rectifying this situation.

This report presents the results of a series of directional stability tests which were performed on a 1/18 scale model of the hull of a 120 ft WPB notional design. The design is a precursor of the Heritage class patrol boat design. Captive model tests were performed to add to a basic data base of hydrodynamic information about planing hulls. This information is required for the study of the dynamic stability, course keeping, maneuvering and control of planing hulls.

Straight course and rotating arm tests, at two radii, were conducted at the Froude scale equivalent of 12.5 and 35 knots. The model was free to trim and heave. Variations in the yaw angle and roll angle were studied, but constrained in surge, sway, roll and yaw. The lateral and longitudinal forces, and roll and yaw moments, were measured. Most of the tests were conducted at a design displacement of 135 long tons. The model was towed from a point corresponding to the longitudinal center of gravity of the design. A limited number of tests were conducted at a displacement corresponding to 155 long tons. Rudder effectiveness tests were performed on a straight course.

A more in depth analysis of the data, involving the use of symmetry arguments and mathematical curve fitting techniques, together with a comparison with other planing hull stability data, remains to be done. This will involve curve fitting mathematical expressions to the hydrodynamic data, and inserting these expressions into equations of motion. The solution of these equations will provide predictions of turning and maneuvering trajectories. A comparison of the trajectories for various planing boat designs will give insight into those hull characteristics that are desirable, as well as, those characteristics that are undesirable.

INTRODUCTION

The Davidson Laboratory is conducting a series of planing boat studies in support of the U.S. Coast Guard's pursuit of R&D projects which will enable it to evaluate advanced marine vehicles and advanced technologies which enhance the effectiveness of ship resources. The experimental results obtained at the Davidson Laboratory are intended to contribute to a relevant technical data base for the evaluation of vessels which are in service and for designs which are being considered for service.

The objective of this research is to obtain basic hydrodynamic information about planing hulls through the use of captive model tests. This information is required for the study of the transverse stability, yaw/roll stability, course keeping, maneuvering and control, and seakeeping and the loss of speed in a seaway of planing hulls.

The research results presented in this report are concerned with the directional stability of the 120 ft WPB Notional Design hull. The course keeping stability tests of the hull were made under a number of conditions including parametric variations in displacement (135 and 155 long tons), yaw angle, roll angle, and rudder deflection. The model was tested at speeds corresponding to 12.5 and 35 knots on straight course, and in turning circles of five and ten boat lengths.

The Coast Guard cautions the reader that the data contained herein only apply to the model tested, as defined by the body lines drawing presented in Figure 3 of this report.

This report is the last in a series of planing hull reports which were prepared under Contract DTCG23-85-C-20060. Funding limitations require that this report be published in two parts. Part I (this volume) contains a description of the model tests and a tabulation of the test data. It was prepared by the Davidson Laboratory. Part II (a companion volume) presents the data in graphical form and discusses the curves drawn through the data. It is being prepared by the USCG R&D Center.

MODEL

The 1/18-scale model of the 120 ft WPB is shown under test in Figure 1. The model was previously fabricated and used for resistance and seakeeping tests^{1,2,3}. The profile and body lines are presented on Figures 2 and 3. The model hull was made of fiberglass and epoxy to USCG specifications. Internal body frames and cut-out decks were included to make the model rigid but lightweight. A lower deck, made of marine plywood, was installed inside the model and extended for about a third of the model's length. This deck was used for attaching weights, instrumentation, and the apparatus which connected the model to the overhead towing carriage.

The model was towed free-to-pitch through a pitch pivot box (see Figure 6) which had its axis located at the Center of Moments (CM), see page 5. This center coincided with the Design LCG but was slightly above the Design VCG, see Table 1.

The bottom of the model was striped to assist in determining the keel and chine wetted lengths from the underwater photographs, see Figure 4. Lines were ruled along the keel, and the upper and lower chines, and tick marks were placed along these lines at one inch intervals. Every fifth line was connected from chine to chine. The origin of this system is the upper chine at the transom.

A thin mylar strip was fastened to the lower chine of the 120 ft WPB to ensure sharp edges on the scaled model. The spray rail built into the 120 ft WPB at the upper chine was V-shaped in cross-section, which resulted in a sharp edge, and therefore no mylar strip was required at the upper chine.

Two adjustable brass rudders were made according to the drawing supplied to the Davidson Laboratory by the Coast Guard, see Figure 5. Simplified constant thickness rudder sections were used, 0.375 inches thick model scale. Note that the rudders are perpendicular to the bottom of the hull as shown on Figure 5. To maintain the watertight integrity of the hull, and for ease of removal, the rudders were mounted on two thin plates which fastened to the outside of the hull rather than penetrating the hull. These rudders were adjustable over the range of rudder deflection from -15 to +15 degrees in five degree increments.

Hull characteristics are presented in Table 1.

TEST FACILITIES

Straight Course Tests

Straight course tests were conducted in the Davidson Laboratory Tank 3 which is 313 ft long, 12 ft wide and 5.5 ft deep. A monorail above the water extends down the tank's length. A towing carriage rides on this rail and is attached to the model below it through the heave poles. The carriage is towed by a steel cable driven by an electric motor at one end of the tank. The model is accelerated up to the required constant speed, and data are acquired in a 50 ft data trap. The signals from the instrumentation are transmitted by overhead cables to shore-based signal conditioning equipment and thence to an on-line computer for processing and storage.

The signal conditioning equipment provides for dc amplification, and zero-offset adjustment, of the signals from the instrumentation, so as to get suitable input levels to the computer. In addition, the input to the computer is displayed on an oscillograph. This oscillograph makes a time-history record of each run, which is monitored to ensure the satisfactory quality of the data that is being obtained. The signals from the instrumentation were not filtered.

Underwater photographs were taken using a water-tight camera box and a large underwater mirror. The rail in Tank 3 is equipped with a counter system which indicates the exact location of the carriage. This system is used to determine when the model is opposite the camera and to fire the camera and flash lights. A color video camera was mounted ahead of the model and off the port side of the model. All runs were monitored on a shore based monitor, and a video recording was made of each run.

Rotating Arm Tests

The rotating arm tests were carried out in Davidson Laboratory Tank 2 which is 75 ft by 75 ft and 4.5 ft deep. The rotating arm is mounted above the water on a central shaft, and is driven by an electric motor and gear box mounted above the shaft. A towing carriage rides on this arm and is attached to the model below it by heave poles. The towing carriage can be slid radially along the arm so as to vary the radius of turn. The model is accelerated up

to the required constant speed, and data are acquired in a data trap spanning 90 degrees of arc set up in the fourth quadrant. The signals from the instrumentation are transmitted through slip rings on the shaft to shore-based signal conditioning equipment and thence to an on-line computer for processing and storage. The model setup on the rotating arm is shown on Figure 1.

Underwater black and white photographs were taken of each test run. The underwater camera was mounted in a vertical, surface piercing, water-tight transparent camera box, with the camera axis horizontal. A mirror set at 45 degrees was positioned on the floor of the tank opposite the camera and underneath the path of the model. This arrangement gave a view from directly underneath the hull looking upward. Flash units on the floor of the tank were used to illuminate the model. The camera and flash were triggered by the passage of the model over the mirror. The drive shaft in Tank 2 is equipped with a shaft encoder which indicates the position of the arm. This feature makes it relatively easy to detect when the model is well positioned over the mirror. The resulting photograph includes the run number and a side view of the hull, as well as the principal pressure area. An example of an underwater picture is included as Figure 4.

A color video camera was mounted ahead of the model and off the port side of the model. All runs were monitored on a shore based monitor, and a video recording was made of each run.

Two sets of prints of all the underwater photographs, in an 8" by 10" format, have been sent to the U.S. Coast Guard R&D Center at Avery Point, Connecticut. All of the negatives are on file at the Davidson Laboratory.

APPARATUS AND INSTRUMENTATION

A pitch and roll pivot box, with provision for setting and locking the trim and roll angles, was mounted in the model. This pivot box is shown on Figure 6. For all these stability tests the model was free to trim and heave, but was fixed in roll and yaw. The pitch axis was located 42.9 ft forward of the aft perpendicular and 8.81 ft above the baseline. Here and hereafter in this report, values are generally given in terms of full-size equivalents unless stated otherwise.

The meaning of the terms "full-size" and "model scale" as used in this report specifically, and at the Davidson Laboratory generally, may need clarification. The difference may be illustrated by reference to the Hull Characteristics given in Table 1. This Table shows, for example, that the LOA of the hull tested is 118.79 ft full-size and 79.19 inches model scale. To take another example, the data trap used for the straight course tests was discussed in a previous section. This data trap was 50 ft long at model scale corresponding to 900 ft full-size: in either case the length of the data trap was of the order of $7\frac{1}{2}$ hull lengths.

The pitch axis coincided with the Design LCG and was positioned as low in the model as the pivot box would allow. The intersection of the pitch axis with the plane of symmetry of the hull forms the origin for the balance coordinate system, and is referred to as the Center of Moments, CM. Lateral force, yaw moment, longitudinal force and roll moment were measured in these tests, as indicated in the sketch in Appendix C, where the various axis systems used to present the data are also described and discussed. The balance coordinate system coincides with the Body Coordinate System A as defined by the U.S. Coast Guard for use with these tests, with two exceptions: a) the origin of the measurement axes is located at the center of moments, which is 1.16 ft above the Design CG origin specified for Systems A and B, and b) the measurement x axis lies in the plane of symmetry of the hull, parallel to the water surface, but points toward the stern. The forces and moments are reported in all three coordinate systems: in balance axes, in the specified Body Coordinate System A, the specified Body Coordinate System B, and in non-dimensional form for both systems A and B.

A five-component balance was attached above the pivot box. A graduated plate on top of the balance was included for setting the yaw angle, and the balance rotated with the model in yaw but not in either roll or trim. Heave was measured at the pitch pivot by a linear differential transformer attached to the heave poles. An inclinometer mounted in the model measured the trim of the keel in the straight course tests. However, since this inclinometer is affected by radial acceleration on the rotating arm, a rotary differential transformer mounted on the pitch axis was used to measure the trim during the turning tests. The five-component balance was attached to twin vertical heave poles in a standard free-to-heave apparatus, which included provision for counter-weighting. The free-to-heave apparatus was mounted on

a standard towing carriage which was either run on the Tank 3 rail, or attached to the Tank 2 arm. Thus the identical test apparatus was used for both the straight course and rotating arm tests. The model was towed at constant speed in the straight course tests, and at constant angular velocity in the rotating arm tests.

TEST PROCEDURE

After the apparatus was setup, the instrumentation was calibrated in place, prior to testing. Known loads and moments were applied to the five component balance, and known displacements to the motion transducers. Combinations of loads and moments were applied to the balance in both the positive and negative sense. The following ranges of calibration were covered:

Drag	0 to 15 lb
Side-force	0 to 50 lb
Roll moment	-10.5 to +10.5 lb-ft
Yaw moment	-12.5 to +12.5 lb-ft
Trim	-3 to +9 degrees
Heave	0 to 10 inches

During calibration, the outputs from the balance transducers were fed to the on-line computer where a multiple linear regression was performed. The resulting coefficients were stored for use during data collection. These coefficients represent the sensitivity of each channel. The gains in the signal conditioning equipment were adjusted so that the sensitivities were of the order of 150 counts per unit of applied load. The calibrations were checked daily by the application of deadweights at a compound angle which caused simultaneous deflections in all the balance transducers.

The water temperature was maintained at a value of 71.5°F which was checked twice daily.

Data acquisition and processing was carried out by the on-line Masscomp computer using a program package designed by the Davidson laboratory known as DAP5. This program digitizes the analog signals from the instrumentation at 250 Hz and records them on disk in digital form during the test run. After the run the processing programs are called upon to process the data according

to user specified parameters. The steady state values are the arithmetic means of the digitized data taken in the data trap, and the number of points averaged varies with the speed and radius of turn:

Full Size Speed knots	Straight Course	Model radius of turn	
		32 ft	16 ft
0.0	5,000	5,000	5,000
12.5	2,510	2,524	1,262
35.0	897	901	451

Table A - Number of points averaged at each speed and radius

The model was setup for test in the following sequence. With the model locked at zero trim, that is with the afterbody keel horizontal, and at zero roll, the yaw angle was set by rotating the model in the horizontal plane; then the roll angle was set by rolling the model about its longitudinal axis. Zeros were taken with the model in the air at the required yaw and roll angles, and at zero trim. The model was then lowered into the water, the trim released, and a zero speed run was made to measure the hydrostatic forces and moments acting on the model. The model was then accelerated up to the required speed, data were acquired in the data trap, and the results were converted into engineering units and stored in the computer. An underwater photograph was taken at the end of the data trap, the model was decelerated and returned for the next run. The rotating arm tests were run in the clockwise direction. Speeds were computed from the time taken to travel through the data trap. Running plots of the measured data were made at tankside to monitor the results.

Air tares were run on the rotating arm with the model at zero trim in air, covering the test ranges of speed, radius, and yaw and roll angle, in order to determine the centrifugal and aerodynamic forces and moments. These air tares were later subtracted from the total forces and moments measured with the model in the water, in order to obtain the total of the hydrodynamic and hydrostatic forces and moments. Air tares were not taken on straight course.

TEST PROGRAM

The directional stability tests were run on straight course and on the rotating arm at 32 ft and 16 ft radius, model scale. The radius of the turn is measured in the horizontal plane from the center of the shaft to the tow point at the centerline of the model. The non-dimensional angular velocity, $r' = L/R$, where L refers to the LOA of 118.79 ft, and R is the radius of the turn, provides a convenient means of identifying the non-dimensional radius. Tests on straight course, and at model radii of 32 ft and 16 ft, correspond to non-dimensional angular velocities of 0, 0.206, and 0.412 respectively.

The stability characteristics of the bare hull at a displacement of 135 long tons, and at speeds of 12.5 and 35 knots, were determined at combined values of yaw angle and roll angle, on both straight course and in turns. Yaw angles ranged from -6 to +12 degrees, and roll angles from -10 to +20 degrees. These tests were repeated for the appended hull with the rudders fixed at zero deflection.

The rudder effectiveness was measured on straight course at a displacement of 135 long tons, and at speeds of 12.5 and 35 knots, and with both the yaw angle and the roll angle set to zero. The tests were made at rudder angles of 0, 5, 10, and 15 degrees.

A limited investigation of the effects of displacement on the bare hull stability characteristics was made at $L/R = 0.206$, by increasing the displacement to 155 long tons, and repeating the tests at 12.5 and 35 knots.

The stability tests were run at speeds of 12.5 and 35 knots, with the LCG at 42.9 ft, generally in accordance with the following test matrix:

	<u>Straight Course</u>	<u>Rotating Arm</u>
Configuration	Bare hull	Bare hull
Displacement, long tons	135	135
Rate of turn, L/R	0	0.206, 0.412
Yaw angle, degrees	0, 6, 9, 12	-6, 0, 6, 9, 12
Roll angle, degrees	0, 10, 20	-10, 0, 10, 20
Yaw angle, degrees	-6	
Roll angle, degrees	-20, -10, 0	

<u>Straight Course</u>		<u>Rotating Arm</u>
Configuration		Bare hull
Displacement, long tons		155
Rate of turn, L/R		0.206
Yaw angle, degrees		-6, 0, 6, 9, 12
Roll angle, degrees		-10, 0, 10, 20
Configuration	Appended hull	Appended hull
Displacement, long tons	135	135
Rate of turn, L/R	0	0.206
Rudder deflection, degrees	0	0
Yaw angle, degrees	0, 6, 9, 12	-6, 0, 6, 9, 12
Roll angle, degrees	0, 10, 20	-10, 0, 10, 20
Rudder Deflection, degrees	0, 5, 10, 15	
Yaw angle, degrees	0	
Roll angle, degrees	0	

The precise combination of test conditions is summarized by the Bare Hull Tests Run Directory in Table 2, and the Appended Hull Tests Run Directory in Table 3.

The model was tested free to trim and heave, and the measured quantities included: the longitudinal and lateral forces, the roll and yaw moments, the trim and heave, and the velocity. The heave is defined as the height of the tow point above the still water surface. The draft of the keel at the transom was calculated from the trim and heave, and is included in the tables of results as the "transom draft" (TD).

Tests at the 16 ft model radius at 35 knots, with -6 degrees of yaw, at either zero roll or with the model rolled 10 degree, overloaded the balance. Consequently tests were run over a range of increasing speeds up to the maximum possible without overloading, so that the data could later be extrapolated. This supplement included a velocity sweep from 7.3 knots to 28 knots at zero roll combined with yaw angles of -5 and -6 degrees, and a roll sweep from -10 to 20 degrees at 17.5 knots and -6 degrees yaw.

The static roll stability was measured at zero speed, and at displacements of 135 and 155 long tons, over a range of roll angles from -20 degrees to +20 degrees.

DATA PROCESSING

The test data were processed to meet several U.S. Coast Guard requirements. These include: 1) a tabulation of the "raw" data on a day by day, run by run basis; 2) the presentation of the data in Body Coordinate System A and System B, and in non-dimensional form; and 3) an explanation of how the lateral and longitudinal forces, and the yaw and roll moments are calculated.

These requirements are met in the following manner. 1) Each run is automatically given a unique, 3-digit, sequence number, and therefore a listing of the run numbers and test conditions satisfies the need for a run by run record. This list is presented in Appendices A and B which are Chronological Run Directories of the straight course tests and the rotating arm tests respectively. The run numbers are assigned sequentially by the computer, and a "run" signifies a data taking event which is not necessarily a run down the tank. The straight course runs were given a prefix of "1" so that these runs lie in the 1000-series. Rotating arm runs at $L/R = 0.206$ (model radius 32 ft) are distinguished by a prefix "2" and lie in the 2000-series. Similarly runs at $L/R = 0.412$ (model radius 16 ft) are prefixed by "3" and lie in the 3000-series. The raw data were taken to be the measured model data corrected for air tares, these data are presented in Tables 5 to 13.

2) The measured data were transformed to the modified body axes system, Body Coordinate System A with origin at the Design CG. This is an orthogonal axes set which rotates with the body in yaw but maintains a vertical and horizontal orientation. These results are presented in Tables 14 to 22.

These data were in turn transformed to Body Coordinate System B, with origin at the Design CG. This is a true body axes system which is fixed in the body and rotates with it in yaw, roll, and trim. The results in Axes B are presented in Tables 23 to 31. Finally the data were non-dimensionalized: forces were normalized with respect to the product of the dynamic pressure and the square of the beam, while moments were normalized with respect to the product of the dynamic pressure and the cube of the beam. The

non-dimensional results are presented in Tables 32 to 38 for Coordinate System A, and in Tables 39 to 45 for Coordinate System B.

3) The various axes systems are described in Appendix C, together with the transformation equations and the non-dimensionalizing scheme. The analysis of the air tares is also presented in Appendix C. The presentation of the data at various stages, together with the transformation equations, provides a clear audit trail between the raw data and the final results, and illustrates the data reduction process.

Air Tares

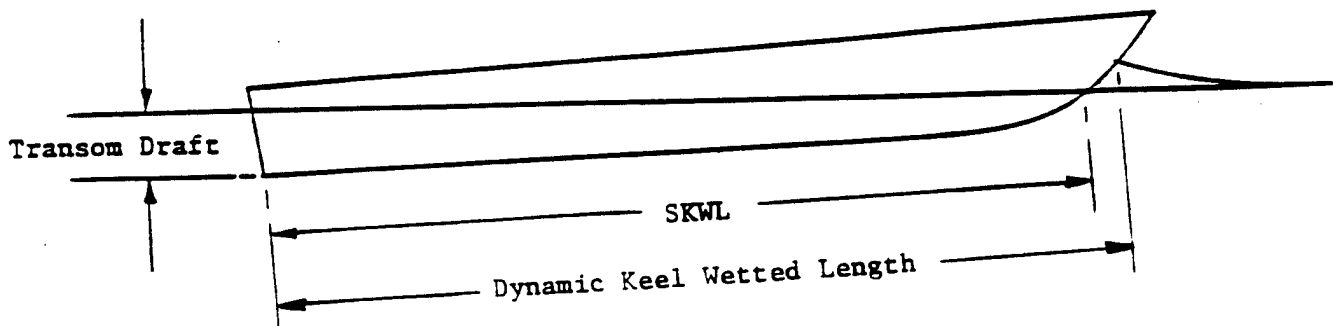
The first step in the analysis of rotating arm data is to remove the inertia effects due to angular acceleration. The inertia forces are measured by running the model in air above the water surface. The observed results are largely due to centrifugal acceleration and are spoken of as air tares. Because of the dominant effect of centrifugal force, the air tares are resolved into forces parallel with and normal to the resultant velocity vector. A regression analysis of the data is performed and equations are adopted to describe the air tare forces and moments, as described in Appendix C. As a check on this procedure the calculated air tares are removed from the observed air tares and the residuals examined. These were sufficiently small to indicate that a satisfactory fit had been obtained. The air tares calculated from the equations in Appendix C are subtracted from all the rotating arm data with the model in the water, before being presented as "Results Without Air Tares" in the tables of results.

Wetted Area

Underwater pictures were used to record the wetted area of the hull in both the straight course and rotating arm tests. An example of one of these photographs taken in a turn at 35 knots is included as Figure 4. Two sets of prints of all the underwater photographs, in an 8" by 10" format, have been supplied to the U.S. Coast Guard R&D Center at Avery Point, Connecticut, for measurement and analysis. All of the negatives are on file at the Davidson Laboratory.

Since the underwater pictures were not measured at the Davidson Laboratory neither the wetted lengths nor the wetted areas are included in the tabulated results.

A quantity known as the "static keel wetted length" (SKWL) was calculated from the trim and the transom draft. The dynamic wetted lengths at keel and chine measured from the underwater photographs may be correlated with the static keel wetted length. The static keel wetted length is defined by the intersection of the still water surface with the keel profile in the running condition and does not allow for the wave rise at the keel. The SKWL is shown in Sketch A:



Sketch A

RESULTS

The chronological lists of the straight course and rotating arm runs, with their test parameters, are presented in Appendices A and B respectively, for a total of 467 good data points. Directories to the runs are included in Tables 2 and 3 for the bare hull and appended hull configurations respectively. The directory of the rudder tests is in Table 4. Each page in these tables refers to runs at one combination of turn rate and load, and identifies the combination of roll angle and yaw angle at which each run was made at speeds of 0, 12.5 and 35 knots.

The measured model test data are presented in Tables 5 to 13. Each of these tables refers to tests at one combination of turn rate and load, and includes data for the three test speeds of 0, 12.5, and 35 knots. The runs on the rotating arm have been corrected for air tares. The data are sorted into a

hierarchy of speed, roll angle, and yaw angle. The tabulated values include: the run number, the roll angle, the yaw angle, the longitudinal force X, the lateral force Y, the vertical force Z, the pitch moment M, the roll moment K, the yaw moment N, the trim, the transom draft TD, the static keel wetted length SKWL, and the speed.

It may be noted that finite values of pitch moment are tabulated even though the model was free to trim. This is due to the offset of the model CG below the pitch axis, CM, and is discussed in the "Free-to-trim testing" section of Appendix C.

In the case of the straight course rudder tests at zero roll and yaw, Table 12, the value of the rudder deflection is tabulated in place of the roll and yaw angles. For the appended hull with rudders, we define a vector along the rudder stock axis that it directed out from the hull. The rudder deflection angle δ is defined to be positive in a clockwise sense looking in the direction of the vector. Thus the positive deflection of the rudders will be seen to increase the lateral force to starboard. In all other appended hull tests the rudders were at zero deflection.

The straight course tests of the appended hull were the first tests conducted. The magnitudes of the forces and moments were initially over estimated, and consequently the gain of the instrumentation was set too low. This applies to Runs 1111 to 1148 in Table 10. The instrumentation was re-calibrated with greater sensitivity, and the tests were repeated: Runs 1209 et seq in Table 10. The results repeated so well that both sets are reported.

Turns at 35 knots at the smallest radius, at -6 degrees of yaw, and 0 and 10 degrees of roll, overloaded the balance. Supplemental tests in the vicinity of this condition are reported in Table 8.

The measured model results converted to Coordinate System A are presented in Tables 14 to 22, and in Body Coordinate System B in Tables 23 to 31. The corresponding non-dimensional results are tabulated in Tables 32 to 38 and in Tables 39 to 45 for Systems A and B respectively.

CONCLUDING REMARKS

The object of this report is to present the results of stability tests of the 120 ft WPB on straight course and on the rotating arm. An analysis of this data set, while desirable, it is outside the scope of this report.

There is very little information in the current literature on the maneuvering characteristics of planing boats. Therefore this study makes a significant contribution to the planing boat technology base that is being developed by the U.S. Coast Guard.

The results of this investigation provide an extensive data base for studying the course keeping stability, maneuvering, and control characteristics of the USCG 120 ft WPB design.

It is recommended that these data be analyzed and used as a basis for developing a modern planing boat maneuvering simulator.

REFERENCES

1. Klosinski, Walter E., and Brown, P. Ward: "Resistance and Seakeeping Model Tests of Two USCG Notional Designs of 110 ft and 120 ft WPB Hulls" Davidson Laboratory Report 2548, February 1987.
USCG R&D Report CG-D-16-93
2. Klosinski, Walter E., and Brown, P. Ward: "Additional Resistance and Seakeeping Model Tests of a USCG 120 ft Notional WPB Design," Davidson Laboratory Report 2561, February 1987.
USCG R&D Report CG-D-17-93
3. Klosinski, Walter E., and Brown, P. Ward: "Additional Seakeeping Model Tests of Two USCG Notional Designs of 110 ft and 120 ft WPB Hulls" Davidson Laboratory Report 2587, February 1987.
USCG R&D Report CG-D-18-93

TABLE 1

HULL CHARACTERISTICS

	Full-Size	1/18 Model Scale
Displacement		
Half load	135.0 ℓ -tons	50.43 lb
Full load	155.0 ℓ -tons	57.90 lb
LOA	118.79 ft	79.19 in
LBP	110.0 ft	73.33 in
Maximum beam at upper chine	21.1 ft	14.07 in
Design Center of Gravity		
LOG forward of AP	42.90 ft	28.60 in
VCG above baseline	7.57 ft	5.05 in
Test Center of Gravity		
LOG forward of AP	42.90 ft	28.60 in
VCG above baseline at 135 ℓ -tons	8.02 ft	5.35 in
VCG above baseline at 155 ℓ -tons	8.12 ft	5.41 in
Test Center of Moments		
LCM forward of AP	42.90 ft	28.60 in
VCM above baseline	8.81 ft	5.875 in
Rudder Characteristics		
Root chord	35.0 in	1.56 in
Tip chord	20.0 in	1.11 in
Span	42.0 in	2.33 in
Lateral area of each rudder	1155.0 sq.in	3.56 sq.in
Total area	2310.0 sq.in	7.13 sq.in
Rudder post fwd of Station 10	37.00 in	2.06 in
Rudder root outboard of CL	51.00 in	2.83 in
Constant model rudder thickness	3.33 in	0.185 in
Inclination of Baseline		
at zero trim of afterbody	0.76 deg	0.76 deg

TABLE 2.1

BARE HULL TESTS RUN DIRECTORY
Displacement 135 long tons, LOG 42.9 ft

L/R = 0 (Straight Course)

Speed = 0 knots

	YAW:	-6°	-3°	0°	3°	6°	9°	11°	12°
ROLL									
-20°		1325							
-10°		1322							
0°		1328		1272	1318	1275	1278	1314 1316	1281
10°				1285	1320	1289	1292		1295
20°				1298	1312	1301	1306		1309

Speed = 12.5 knots

	YAW:	-6°	-3°	0°	3°	6°	9°	11°	12°
ROLL									
-20°		1326							
-10°		1323							
0°		1329		1273		1276	1279		1282 1283
10°				1286		1290	1293		1296
20°				1299		1302	1307		1310

Speed = 35 knots

	YAW:	-6°	-3°	0°	3°	6°	9°	11°	12°
ROLL									
-20°		1327							
-10°		1324							
0°		1330		1274	1319	1277	1280	1315 1317	1284
10°				1287 1288	1321	1291	1294		1297
20°				1300	1313	1305	1308		1311

TABLE 2.2

BARE HULL TESTS RUN DIRECTORY
Displacement 135 long tons, LOG 42.9 ft

L/R = 0.206 (32 ft radius)

Speed = 0 knots

	YAW:	-6°	-3°	0°	3°	6°	9°	12°
ROLL -10°		2198 2200		2137		2153	2175	2195
0°		2202		2133 2135		2146 2147		2192
10°		2205		2140		2156	2178	2188
20°		2208 2210		2143		2160	2181	2184 2185

Speed = 12.5 knots

	YAW:	-6°	-3°	0°	3°	6°	9°	12°
ROLL -10°		2201		2138		2154	2176	2196
0°		2203		2134		2150 2151	2173	2193
10°		2206		2141		2157	2179	2189
20°		2209		2144		2161	2182	2186

Speed = 35 knots

	YAW:	-6°	-3°	0°	3°	6°	9°	12°
ROLL -10°		2199		2139		2155	2177	2197
0°		2204 2556		2136 2557		2152 2558	2174	2194 2559
10°		2212		2142		2158	2180	2190 2191
20°		2211		2145		2162	2183	2187

TABLE 2.3a

BARE HULL TESTS RUN DIRECTORY
Displacement 135 long tons, LOG 42.9 ft

L/R = 0.412 (16 ft radius)

Speed = 0 knots

	YAW:	-6°	-3°	0°	3°	6°	9°	12°
ROLL								
-10°		3322 3373		3319		3337	3356	3359
0°		3380		3310		3334	3352 3353	3363
10°		3387		3313		3340	3349	3365
20°		3391 3392		3316		3343	3346	3368

Speed = 12.5 knots

	YAW:	-6°	-3°	0°	3°	6°	9°	12°
ROLL								
-10°		3323		3320		3338	3357	3360
0°		3381 3382		3311		3335	3354	3363
10°		3388		3314		3341	3350	3366
20°		3393		3317		3344	3347	3369

Speed = 35 knots

	YAW:	-6°	-3°	0°	3°	6°	9°	12°
ROLL								
-10°		3375		3321		3339	3358	3361
0°		*		3312		3336	3355	3364
10°		*		3315		3342	3351	3367
20°		3395		3318		3345	3348	3371

* Overloaded roll moment - see table 2.3b

TABLE 2.3b

BARE HULL TESTS RUN DIRECTORY
Displacement 135 long tons, LCG 42.9 ft

L/R = 0.412 (16 ft radius)

Yaw = -5°

ROLL	SPEED: knots							
	0	7.3	12.5	15	17.5	22.8	26	28
0°	3432		3429	3434	3430	3431		3433

Yaw = -6°

ROLL	SPEED: knots							
	0	7.3	12.5	15	17.5	22.8	26	28
-10°	3406				3407			
0°	3403	3441	3435	3440	3405	3384	3385	
	3404				3412	3438	3390	
	3436				3437			
10°	3408				3409			
20°	3410				3411		3394	

TABLE 2.4
BARE HULL TESTS RUN DIRECTORY
Displacement 155 long tons, LOG 42.9 ft

L/R = 0.206 (32 ft radius)

Speed = 0 knots

ROLL	YAW:	-6°	-3°	0°	3°	6°	9°	12°
-10°		2529		2461		2479	2482	2506
0°		2442 2526		2458		2476	2485	2503
10°		2523		2464		2473	2488 2489	2509 2510
20°		2520		2467 2518		2470 2516	2492	2513

Speed = 12.5 knots

ROLL	YAW:	-6°	-3°	0°	3°	6°	9°	12°
-10°		2530		2462		2480	2483	2507
0°		2527		2459		2477	2486	2504
10°		2524		2465		2474	2490	2511
20°		2521		2468		2471	2493	2514

Speed = 35 knots

ROLL	YAW:	-6°	-3°	0°	3°	6°	9°	12°
-10		2531		2463		2481	2484	2508
0		2528		2460		2478	2487	2505
10		2525		2466		2475	2491	2512
20		2522		2469 2519		2472 2517	2494	2515

TABLE 3.1

APPENDED HULL TESTS RUN DIRECTORY
Displacement 135 tons, LOG 42.9 ft

L/R = 0 (Straight Course)

Speed = 0 knots

ROLL	YAW:	-6°	-3°	0°	3°	6°	9°	12°
-10°								
0°				1111		1114	1117	1120
				1209		1219	1222	1225
				1215				
10°				1123		1126	1129	1132
				1228		1231	1234	1237
20°				1137	1252	1140	1143	1146
				1240		1243	1246	1249

Speed = 12.5 knots

ROLL	YAW:	-6°	-3°	0°	3°	6°	9°	12°
-10°								
0°				1112		1115	1118	1121
				1210		1220	1223	1226
				1216				
10°				1124		1127	1130	1133
				1229		1232	1235	1238
20°				1138	1253	1141	1144	1147
				1241		1244	1247	1250

Speed = 35 knots

ROLL	YAW:	-6°	-3°	0°	3°	6°	9°	12°
-10°								
0°				1113		1116	1119	1122
				1217		1221	1224	1227
				1218				
10°				1125		1128	1131	1134
				1136		1135	1236	1239
				1230		1233		
20°				1139	1254	1142	1145	1148
				1242		1245	1248	1251

TABLE 3.2

APPENDED HULL TESTS RUN DIRECTORY
Displacement 135 tons, LCG 42.9 ft

L/R = 0.206 (32 ft radius)

Speed = 0 knots

	YAW:	-6°	-3°	0°	3°	6°	9°	12°
ROLL -10°		2274		2216		2241	2251	2271
0°		2280		2213		2245	2248	2267
10°		2283		2228		2238	2254	2264
20°		2286		2232		2235	2257	2261

Speed = 12.5 knots

	YAW:	-6°	-3°	0°	3°	6°	9°	12°
ROLL -10°		2278	2276	2217		2242 2243	2252	2272
0°		2281		2214		2246	2249	2268
10°		2284		2229		2239	2255	2265
20°		2287		2233		2236	2258	2262

Speed = 35 knots

	YAW:	-6°	-3°	0°	3°	6°	9°	12°
ROLL -10°		2279	2278	2218		2244	2253	2273
0°		2282		2215		2247	2250	2269
10°		2285		2230		2240	2256	2266
20°		2289		2234		2237	2260	2263

TABLE 4

RUDDER EFFECTIVENESS TESTS RUN DIRECTORY
 Displacement 135 tons, LCG 42.9 ft

L/R = 0 (Straight Course)

Roll = Yaw = 0°

Speed = 0 knots

Rudder angle:	0°	5°	10°	15°
	1209	1263	1259	1255

Speed = 12.5 knots

Rudder angle:	0°	5°	10°	15°
	1210	1265	1261	1256

Speed = 35 knots

Rudder angle:	0°	5°	10°	15°
	1217	1264	1260	1257
	1218		1262	1258

TABLE 5.1

BARE HULL RESULTS, L/R = 0
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	SKWL inch	Speed fps
SPEED = 0 knots												
1325	-20	-6	0.2	-0.1	50.43	4.02	-0.01	0.1	-0.4	2.81	71.7	0.00
1322	-10	-6	0.3	0.0	50.43	2.53	-0.02	0.1	-0.3	2.81	71.6	0.00
1328	0	-6	0.3	-0.1	50.43	-0.12	-0.02	0.1	-0.3	2.83	71.7	0.00
1272	0	0	0.3	0.0	50.43	-0.11	-0.02	0.1	-0.3	2.79	71.6	0.00
1318	0	3	0.2	0.0	50.43	-0.09	-0.02	0.1	-0.3	2.82	71.6	0.00
1275	0	6	0.2	0.0	50.43	-0.11	-0.02	0.1	-0.3	2.83	71.6	0.00
1278	0	9	0.2	0.0	50.43	-0.11	-0.02	0.1	-0.3	2.79	71.6	0.00
1316	0	11	0.2	0.0	50.43	-0.06	-0.02	0.1	-0.3	2.86	71.7	0.00
1281	0	12	0.2	0.0	50.43	-0.08	-0.02	0.1	-0.3	2.79	71.6	0.00
1314	0	12	0.2	0.1	50.43	-0.04	-0.02	0.1	-0.3	2.80	71.6	0.00
1285	10	0	0.3	0.0	50.43	-2.77	-0.02	0.1	-0.2	2.84	71.5	0.00
1320	10	3	0.2	0.0	50.43	-2.75	-0.02	0.1	-0.2	2.84	71.5	0.00
1289	10	6	0.3	0.0	50.43	-2.73	-0.02	0.1	-0.2	2.84	71.5	0.00
1292	10	9	0.2	0.0	50.43	-2.72	-0.02	0.1	-0.2	2.86	71.5	0.00
1295	10	12	0.2	0.1	50.43	-2.71	-0.02	0.1	-0.2	2.85	71.5	0.00
1298	20	0	0.3	0.0	50.43	-4.20	-0.02	0.1	-0.2	2.83	71.4	0.00
1312	20	3	0.3	0.0	50.43	-4.19	-0.02	0.1	-0.2	2.82	71.4	0.00
1301	20	6	0.2	0.0	50.43	-4.18	-0.02	0.1	-0.2	2.83	71.4	0.00
1306	20	9	0.2	0.0	50.43	-4.16	-0.02	0.1	-0.2	2.81	71.3	0.00
1309	20	12	0.2	0.0	50.43	-4.14	-0.02	0.1	-0.2	2.83	71.4	0.00
SPEED = 12.5 knots												
1326	-20	-6	2.3	-1.0	50.43	3.89	-0.03	-1.2	0.0	3.21	71.6	4.98
1323	-10	-6	2.3	-0.8	50.43	2.39	-0.03	-1.7	0.0	3.27	71.6	4.97
1329	0	-6	2.3	-0.9	50.43	-0.02	-0.03	-1.9	0.1	3.29	71.6	4.98
1273	0	0	2.1	0.0	50.43	-0.10	-0.03	0.1	0.0	3.20	71.6	4.97
1276	0	6	2.3	1.0	50.43	-0.22	-0.03	2.5	0.1	3.28	71.6	4.98
1279	0	9	2.3	1.7	50.43	-0.25	-0.03	4.2	0.0	3.27	71.7	4.98
1282	0	12	2.4	2.9	50.43	-0.22	-0.03	6.4	0.0	3.31	71.8	4.97
1283	0	12	2.4	2.8	50.43	-0.24	-0.03	6.3	0.0	3.33	71.8	4.98
1286	10	0	2.2	-0.1	50.43	-2.59	-0.03	0.1	0.1	3.25	71.5	4.98
1290	10	6	2.3	1.0	50.43	-2.60	-0.03	2.2	0.1	3.29	71.5	4.97
1293	10	9	2.3	1.7	50.43	-2.61	-0.03	3.8	0.1	3.31	71.6	4.98
1296	10	12	2.4	2.6	50.43	-2.60	-0.03	5.8	0.0	3.33	71.7	4.98
1299	20	0	2.1	-0.1	50.43	-4.04	-0.03	-0.2	0.2	3.18	71.3	4.98
1302	20	6	2.3	1.1	50.43	-4.08	-0.03	1.6	0.2	3.26	71.3	4.98
1307	20	9	2.4	1.9	50.43	-4.11	-0.03	2.8	0.2	3.29	71.4	4.97
1310	20	12	2.4	2.8	50.43	-4.17	-0.03	4.3	0.1	3.30	71.5	4.97

TABLE 5.2

BARE HULL RESULTS, L/R = 0
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	SKWL inch	Speed fps
SPEED = 35 knots												
1327	-20	-6	8.0	-9.6	50.43	2.16	-0.10	0.0	2.0	3.43	67.5	13.94
1324	-10	-6	7.7	-8.8	50.43	0.40	-0.10	-2.4	1.9	3.44	67.7	13.93
1274	0	0	7.5	0.3	50.43	-0.16	-0.09	0.5	1.7	3.33	68.1	13.93
1319	0	3	7.6	5.3	50.43	0.56	-0.10	3.7	1.9	3.45	67.9	13.93
1277	0	6	8.1	11.1	50.43	1.31	-0.12	4.8	2.3	3.66	67.2	13.95
1280	0	9	8.6	17.8	50.43	2.33	-0.14	3.3	2.8	3.97	66.2	13.93
1317	0	11	9.0	22.3	50.43	3.01	-0.15	1.8	3.2	4.19	65.2	13.92
1284	0	12	9.3	25.3	50.43	3.42	-0.16	0.5	3.5	4.32	64.2	13.94
1315	0	12	9.2	25.1	50.43	3.42	-0.16	0.6	3.5	4.27	64.2	13.92
1287	10	0	7.8	-0.5	50.43	-2.29	-0.10	-2.4	1.9	3.40	67.9	13.93
1288	10	0	7.7	-0.5	50.43	-2.29	-0.10	-2.4	1.8	3.37	67.9	13.92
1321	10	3	7.6	5.0	50.43	-1.51	-0.10	1.5	1.9	3.36	67.7	13.95
1291	10	6	7.7	10.3	50.43	-0.53	-0.11	2.4	2.1	3.48	67.2	13.93
1294	10	9	7.8	15.7	50.43	0.83	-0.13	0.0	2.8	3.73	65.5	13.92
1297	10	12	8.1	20.3	50.43	1.95	-0.14	-0.2	3.0	3.73	64.3	13.95
1300	20	0	8.2	-1.1	50.43	-3.83	-0.10	-2.9	2.1	3.46	67.4	13.93
1313	20	3	8.1	4.9	50.43	-3.29	-0.10	-0.9	2.0	3.41	67.4	13.90
1305	20	6	8.0	11.9	50.43	-2.35	-0.11	-1.8	2.4	3.54	66.4	13.93
1308	20	9	7.5	18.0	50.43	-1.09	-0.13	-2.6	2.8	3.60	64.9	13.94
1311	20	12	7.2	21.0	50.43	0.00	-0.13	-1.8	2.7	3.35	64.1	13.93

TABLE 6.1

BARE HULL RESULTS, L/R = 0.206, WITHOUT AIR TARES
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	SKWL inch	Speed fps
SPEED = 0 knots												
2198	-10	-6	0.2	-0.2	50.43	2.10	-0.03	0.0	0.0	2.99	71.3	0.00
2137	-10	0	0.2	-0.1	50.43	2.15	-0.03	0.0	0.0	2.84	71.0	0.00
2153	-10	6	0.2	-0.1	50.43	2.32	-0.03	0.1	0.1	2.98	71.2	0.00
2175	-10	9	0.2	-0.1	50.43	2.12	-0.03	0.0	0.1	2.99	71.2	0.00
2195	-10	12	0.2	-0.1	50.43	2.18	-0.03	0.1	0.1	3.00	71.2	0.00
2202	0	-6	0.2	-0.2	50.43	-0.50	-0.03	0.0	-0.1	2.92	71.4	0.00
2133	0	0	0.2	0.0	50.43	-0.37	-0.03	-0.1	-0.1	2.82	71.2	0.00
2135	0	0	0.2	-0.1	50.43	-0.42	-0.03	0.0	-0.1	2.81	71.2	0.00
2147	0	6	0.2	-0.1	50.43	-0.44	-0.03	0.1	-0.1	2.88	71.3	0.00
2146	0	6	0.2	-0.1	50.43	-0.45	-0.03	0.1	-0.1	2.88	71.3	0.00
2192	0	12	0.2	-0.1	50.43	-0.48	-0.03	0.1	0.0	2.94	71.3	0.00
2205	10	-6	0.2	-0.1	50.43	-3.13	-0.03	0.0	-0.1	2.90	71.4	0.00
2140	10	0	0.2	-0.1	50.43	-3.10	-0.03	0.0	-0.1	2.75	71.1	0.00
2156	10	6	0.2	-0.1	50.43	-2.88	-0.03	0.1	-0.1	2.93	71.3	0.00
2178	10	9	0.2	-0.1	50.43	-3.09	-0.03	0.1	0.0	2.92	71.3	0.00
2188	10	12	0.2	-0.1	50.43	-3.14	-0.03	0.1	0.0	2.93	71.3	0.00
2208	20	-6	0.2	-0.2	50.43	-4.65	-0.02	0.0	-0.1	2.78	71.2	0.00
2210	20	-6	0.2	-0.1	50.43	-4.64	-0.02	0.0	-0.1	2.78	71.2	0.00
2143	20	0	0.2	-0.1	50.43	-4.47	-0.02	0.0	-0.1	2.64	70.9	0.00
2160	20	6	0.2	-0.1	50.43	-4.56	-0.02	0.1	-0.1	2.83	71.2	0.00
2181	20	9	0.1	-0.1	50.43	-4.50	-0.02	0.1	-0.1	2.83	71.2	0.00
2184	20	12	0.2	-0.1	50.43	-4.53	-0.03	0.1	0.0	2.83	71.2	0.00
SPEED = 12.5 knots												
2201	-10	-6	2.1	-1.4	50.43	2.08	-0.04	-4.6	0.3	3.42	71.5	4.98
2138	-10	0	2.2	-0.1	50.43	1.97	-0.04	-1.8	0.4	3.34	71.0	4.98
2154	-10	6	2.5	1.0	50.43	1.89	-0.05	0.1	0.6	3.58	71.1	4.97
2176	-10	9	2.6	1.7	50.43	1.49	-0.06	0.9	0.7	3.69	71.1	4.99
2196	-10	12	2.8	2.8	50.43	1.40	-0.06	1.9	0.8	3.82	71.1	4.98
2203	0	-6	2.0	-1.7	50.43	-0.31	-0.04	-5.0	0.2	3.39	71.6	4.96
2134	0	0	2.2	-0.1	50.43	-0.28	-0.04	-2.0	0.3	3.34	71.2	5.00
2150	0	6	2.4	0.8	50.43	-0.45	-0.05	0.2	0.5	3.50	71.2	4.95
2151	0	6	2.4	0.8	50.43	-0.47	-0.05	0.2	0.5	3.50	71.2	4.96
2173	0	9	2.4	1.5	50.43	-0.57	-0.05	1.0	0.5	3.59	71.2	4.93
2193	0	12	2.6	2.3	50.43	-0.66	-0.05	2.2	0.6	3.69	71.2	4.97
2206	10	-6	2.1	-1.8	50.43	-2.84	-0.04	-5.0	0.2	3.37	71.5	4.98
2141	10	0	2.2	-0.2	50.43	-2.87	-0.04	-2.0	0.3	3.24	71.1	4.99
2157	10	6	2.4	0.8	50.43	-2.69	-0.05	0.1	0.5	3.48	71.2	4.98
2179	10	9	2.5	1.6	50.43	-2.87	-0.05	0.8	0.5	3.55	71.1	4.98
2189	10	12	2.6	2.3	50.43	-2.93	-0.05	1.9	0.5	3.61	71.2	4.98

TABLE 6.2

BARE HULL RESULTS, L/R = 0.206, WITHOUT AIR TARES
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	SKWL inch	Speed fps
SPEED = 12.5 knots												
2209	20	-6	2.0	-1.7	50.43	-4.54	-0.03	-5.0	0.1	3.25	71.4	4.98
2144	20	0	2.2	-0.1	50.43	-4.41	-0.04	-2.2	0.3	3.12	70.9	4.98
2161	20	6	2.5	1.2	50.43	-4.51	-0.05	-0.6	0.5	3.41	71.1	4.98
2182	20	9	2.4	2.1	50.43	-4.57	-0.05	-0.1	0.5	3.47	71.0	4.97
2186	20	12	2.6	3.1	50.43	-4.60	-0.05	0.6	0.5	3.52	71.1	4.99
SPEED = 35 knots												
2199	-10	-6	7.3	-10.3	50.43	-0.07	-0.12	-12.0	2.5	3.92	67.3	13.94
2139	-10	0	7.4	0.3	50.43	0.86	-0.12	-5.8	2.4	3.71	67.0	14.02
2155	-10	6	8.5	12.5	50.43	0.37	-0.14	-4.1	3.0	4.29	66.5	13.84
2177	-10	9	9.0	20.6	50.43	-0.37	-0.17	-8.2	3.8	4.77	64.7	13.90
2197	-10	12	9.8	28.3	50.43	-1.06	-0.21	-12.7	4.7	5.31	62.3	13.91
2204	0	-6	7.7	-13.3	50.43	-1.60	-0.11	-20.6	2.2	3.88	68.0	13.86
2556	0	-6	7.1	-13.0	50.43	-1.66	-0.12	-20.5	2.3	3.86	67.8	13.95
2136	0	0	7.2	-1.2	50.43	-1.09	-0.11	-9.1	2.1	3.61	67.5	13.93
2557	0	0	7.3	-0.8	50.43	-1.17	-0.11	-8.9	2.2	3.70	67.6	13.95
2152	0	6	7.7	10.2	50.43	-0.72	-0.14	-5.5	2.8	4.09	66.6	13.84
2558	0	6	7.7	10.6	50.43	-0.81	-0.14	-5.5	2.9	4.07	66.3	13.95
2174	0	9	8.0	16.7	50.43	-0.78	-0.16	-7.3	3.4	4.35	65.2	13.87
2194	0	12	8.5	23.6	50.43	-0.79	-0.18	-10.4	3.9	4.66	63.5	13.90
2559	0	12	8.6	23.7	50.43	-0.82	-0.18	-10.3	4.0	4.65	63.1	13.95
2212	10	-6	8.8	-16.1	50.43	-2.85	-0.11	-25.9	2.1	3.96	68.5	13.94
2142	10	0	7.8	-2.3	50.43	-3.06	-0.10	-11.6	1.8	3.38	68.0	13.94
2158	10	6	7.4	8.9	50.43	-2.32	-0.12	-5.1	2.3	3.73	67.3	13.88
2180	10	9	7.5	15.3	50.43	-1.82	-0.14	-6.1	2.9	3.96	66.1	13.94
2190	10	12	7.7	19.8	50.43	-1.31	-0.15	-7.5	3.1	4.03	65.0	13.90
2191	10	12	7.6	19.9	50.43	-1.31	-0.15	-7.5	3.1	4.03	65.0	13.92
2211	20	-6	8.8	-13.3	50.43	-4.95	-0.13	-18.4	2.7	4.04	67.0	13.95
2145	20	0	7.9	-1.7	50.43	-4.83	-0.10	-12.5	2.0	3.38	67.3	13.96
2162	20	6	7.6	9.8	50.43	-4.51	-0.10	-7.2	2.1	3.55	67.5	13.91
2183	20	9	7.5	16.5	50.43	-3.84	-0.11	-6.5	2.3	3.59	67.1	13.88
2187	20	12	6.8	20.0	50.43	-2.97	-0.11	-5.9	2.3	3.45	66.5	13.94

TABLE 7.1

BARE HULL RESULTS, L/R = 0.412, WITHOUT AIR TARES
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	SKWL inch	Speed fps
SPEED = 0 knots												
3322	-10	-6	0.2	0.0	50.43	2.18	-0.03	0.1	0.0	2.92	71.3	0.00
3373	-10	-6	0.2	0.0	50.43	2.17	-0.03	-0.0	0.0	2.86	71.2	0.00
3319	-10	0	0.2	0.0	50.43	2.16	-0.03	0.0	0.0	2.92	71.3	0.00
3337	-10	6	0.2	-0.1	50.43	2.16	-0.03	0.0	0.0	2.86	71.1	0.00
3356	-10	9	0.2	-0.0	50.43	2.09	-0.03	0.0	0.0	2.88	71.1	0.00
3359	-10	12	0.2	0.0	50.43	2.15	-0.03	0.1	0.0	2.88	71.1	0.00
3380	0	-6	0.2	-0.1	50.43	-0.48	-0.03	0.0	-0.1	2.81	71.3	0.00
3310	0	0	0.1	-0.1	50.43	-0.47	-0.03	0.0	-0.1	2.88	71.3	0.00
3334	0	6	0.2	-0.0	50.43	-0.47	-0.03	0.0	-0.1	2.80	71.3	0.00
3352	0	9	0.2	-0.0	50.43	-0.51	-0.03	0.0	-0.1	2.81	71.3	0.00
3363	0	12	0.2	0.0	50.43	-0.49	-0.03	0.1	-0.1	2.83	71.2	0.00
3387	10	-6	0.1	0.0	50.43	-3.14	-0.02	-0.0	-0.2	2.77	71.3	0.00
3313	10	0	0.2	0.0	50.43	-3.10	-0.03	0.0	-0.1	2.86	71.3	0.00
3340	10	6	0.2	-0.0	50.43	-3.18	-0.03	0.0	-0.1	2.82	71.2	0.00
3349	10	9	0.2	-0.0	50.43	-3.12	-0.03	0.0	-0.1	2.82	71.2	0.00
3365	10	12	0.2	0.0	50.43	-3.18	-0.03	0.1	-0.1	2.82	71.2	0.00
3392	20	-6	0.1	0.0	50.43	-4.61	-0.02	-0.0	-0.2	2.65	71.2	0.00
3316	20	0	0.1	0.0	50.43	-4.50	-0.02	0.1	-0.1	2.76	71.2	0.00
3343	20	6	0.2	-0.1	50.43	-4.49	-0.02	0.0	-0.1	2.72	71.1	0.00
3346	20	9	0.2	-0.1	50.43	-4.54	-0.02	0.1	-0.1	2.73	71.1	0.00
3368	20	12	0.2	0.0	50.43	-4.58	-0.02	0.1	-0.1	2.73	71.1	0.00
SPEED = 12.5 knots												
3323	-10	-6	2.1	-2.2	50.43	2.29	-0.03	-8.8	0.0	3.29	71.7	4.98
3320	-10	0	2.3	-0.1	50.43	1.96	-0.04	-4.0	0.4	3.42	71.3	4.98
3338	-10	6	2.7	1.3	50.43	1.52	-0.06	-1.6	0.7	3.56	70.8	4.98
3357	-10	9	2.9	2.2	50.43	1.23	-0.06	-1.2	0.9	3.72	70.7	4.98
3360	-10	12	3.2	3.3	50.43	1.00	-0.07	-1.0	1.1	3.90	70.6	5.00
3381	0	-6	2.0	-2.8	50.43	-0.17	-0.03	-9.4	0.0	3.20	71.6	4.97
3382	0	-6	2.0	-2.8	50.43	-0.14	-0.03	-9.3	0.0	3.21	71.6	4.94
3311	0	0	2.2	-0.4	50.43	-0.36	-0.04	-4.4	0.3	3.38	71.3	4.97
3335	0	6	2.5	1.0	50.43	-0.55	-0.05	-1.6	0.5	3.46	71.0	4.99
3354	0	9	2.7	1.7	50.43	-0.67	-0.06	-0.9	0.7	3.57	70.9	4.99
3362	0	12	3.0	2.5	50.43	-0.80	-0.06	-0.3	0.9	3.73	70.8	4.99
3388	10	-6	2.1	-3.0	50.43	-2.76	-0.03	-9.3	0.0	3.16	71.6	5.00
3314	10	0	2.4	-0.3	50.43	-2.83	-0.04	-4.5	0.3	3.37	71.3	4.97
3341	10	6	2.6	1.2	50.43	-2.92	-0.05	-1.9	0.6	3.44	70.9	4.98
3350	10	9	2.8	2.0	50.43	-2.83	-0.06	-1.1	0.7	3.54	70.8	4.99
3366	10	12	2.9	2.7	50.43	-2.87	-0.06	-0.4	0.7	3.59	70.8	4.98

TABLE 7.2

BARE HULL RESULTS, L/R = 0.412, WITHOUT AIR TARES
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	SKWL inch	Speed fps
SPEED = 12.5 knots												
3393	20	-6	2.0	-2.2	50.43	-4.54	-0.03	-8.2	0.0	3.04	71.4	4.98
3317	20	0	2.3	-0.2	50.43	-4.51	-0.04	-4.7	0.3	3.29	71.2	4.98
3344	20	6	2.6	1.7	50.43	-4.59	-0.05	-2.6	0.5	3.33	70.8	4.99
3347	20	9	2.9	2.7	50.43	-4.67	-0.05	-2.1	0.7	3.48	70.7	4.97
3369	20	12	3.0	3.7	50.43	-4.75	-0.06	-1.9	0.8	3.55	70.7	4.97
SPEED = 35 knots												
3375	-10	-6	7.7	-13.4	50.43	-0.30	-0.11	-30.4	2.2	3.79	67.9	14.00
3321	-10	0	7.4	0.9	50.43	-0.25	-0.13	-15.3	2.6	3.98	67.0	13.97
3339	-10	6	8.6	16.6	50.43	-1.55	-0.17	-16.2	3.7	4.52	64.2	13.98
3358	-10	9	9.4	25.2	50.43	-2.49	-0.20	-20.6	4.5	5.01	61.7	14.01
3361	-10	12	10.2	34.4	50.43	-3.83	-0.24	-27.3	5.6	5.60	57.3	14.00
3312	0	0	7.4	-2.3	50.43	-1.69	-0.11	-20.6	2.2	3.75	67.8	13.86
3336	0	6	7.9	12.8	50.43	-1.98	-0.15	-15.1	3.1	4.13	65.6	13.98
3355	0	9	8.5	19.8	50.43	-2.20	-0.17	-17.8	3.6	4.38	63.7	13.88
3364	0	12	8.9	27.3	50.43	-2.46	-0.19	-21.3	4.3	4.72	61.3	13.89
3315	10	0	7.9	-4.9	50.43	-2.95	-0.08	-26.7	1.4	3.37	69.0	13.99
3342	10	6	7.6	9.8	50.43	-3.08	-0.11	-14.4	2.2	3.56	67.1	13.98
3351	10	9	7.7	16.3	50.43	-2.48	-0.13	-13.6	2.6	3.70	66.3	13.99
3367	10	12	7.6	21.4	50.43	-1.75	-0.13	-13.9	2.8	3.75	65.3	14.01
3395	20	-6	8.7	-10.3	50.43	-5.79	-0.12	-24.7	2.6	3.74	66.4	13.99
3318	20	0	7.9	-2.5	50.43	-5.30	-0.09	-25.4	1.7	3.41	68.2	14.00
3345	20	6	7.6	9.5	50.43	-4.77	-0.09	-16.1	1.6	3.14	68.0	13.93
3348	20	9	7.4	15.5	50.43	-4.06	-0.08	-13.3	1.5	3.08	68.0	14.00
3371	20	12	7.2	20.7	50.43	-3.12	-0.07	-10.4	1.3	2.93	68.2	13.91

TABLE 8

SUPPLEMENTAL BARE HULL RESULTS, L/R = 0.412, WITHOUT AIR TARES
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	SKWL inch	Speed fps
SPEED = 0 to 28 knots												
3428	0	-5	0.1	-0.1	50.43	-0.48	-0.03	0.0	-0.1	2.82	71.3	0.00
3429	0	-5	2.1	-2.2	50.43	-0.23	-0.03	-8.2	0.0	3.23	71.6	4.94
3434	0	-5	3.2	-3.4	50.43	-0.20	-0.05	-13.1	0.5	3.63	71.3	5.98
3430	0	-5	4.2	-4.5	50.43	-0.29	-0.08	-17.2	1.3	4.10	70.5	6.94
3431	0	-5	5.5	-7.4	50.43	-0.83	-0.10	-23.8	1.9	4.16	69.5	9.05
3433	0	-5	6.5	-12.8	50.43	-0.69	-0.08	-34.2	1.3	3.67	69.8	11.08
3406	-10	-6	0.1	-0.1	50.43	2.13	-0.03	0.0	0.0	2.82	71.0	0.00
3403	0	-6	0.1	-0.1	50.43	-0.50	-0.03	0.0	-0.1	2.74	71.1	0.00
3436	0	-6	0.1	-0.1	50.43	-0.54	-0.02	0.0	-0.2	2.81	71.4	0.00
3408	10	-6	0.1	0.0	50.43	-3.14	-0.03	-0.0	-0.1	2.72	71.1	0.00
3391	20	-6	0.1	0.0	50.43	-4.59	-0.02	-0.0	-0.2	2.64	71.2	0.00
3410	20	-6	0.1	0.3	50.43	-4.58	-0.02	0.1	-0.3	2.58	71.2	0.00
3441	0	-6	0.6	-0.6	50.43	-0.44	-0.02	-2.4	-0.2	2.92	71.5	2.92
3435	0	-6	2.0	-2.7	50.43	-0.27	-0.03	-9.4	0.0	3.19	71.6	4.97
3440	0	-6	3.1	-4.2	50.43	-0.22	-0.04	-15.3	0.4	3.62	71.5	5.99
3407	-10	-6	4.3	-4.5	50.43	2.01	-0.08	-17.3	1.4	4.09	70.3	7.02
3405	0	-6	4.3	-5.6	50.43	-0.24	-0.08	-20.1	1.4	4.05	70.3	7.03
3412	0	-6	4.3	-5.6	50.43	-0.24	-0.08	-20.1	1.3	4.08	70.5	7.01
3437	0	-6	4.3	-5.7	50.43	-0.35	-0.08	-20.2	1.3	4.13	70.6	7.06
3409	10	-6	4.4	-6.0	50.43	-2.85	-0.08	-21.1	1.3	4.02	70.4	7.02
3411	20	-6	4.7	-3.7	50.43	-4.95	-0.08	-16.7	1.4	3.93	70.1	7.02
3384	0	-6	5.2	-7.9	50.43	-0.61	-0.10	-25.4	1.9	4.24	69.5	8.66
3438	0	-6	5.6	-9.1	50.43	-0.89	-0.10	-27.0	1.9	4.19	69.5	9.06
3385	0	-6	5.9	-12.9	50.43	-0.59	-0.09	-34.4	1.5	3.87	69.8	10.22
3390	10	-6	6.5	-13.8	50.43	-3.02	-0.09	-35.0	1.6	3.82	69.5	10.42
3394	20	-6	6.8	-8.9	50.43	-5.18	-0.10	-26.1	1.9	3.83	68.6	10.41

TABLE 9.1

BARE HULL RESULTS, L/R = 0.206, WITHOUT AIR TARES
Displacement 155 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	SKWL inch	Speed fps
SPEED = 0 knots												
2529	-10	-6	0.3	-0.1	57.90	2.35	-0.03	0.0	0.1	3.25	71.4	0.00
2461	-10	0	0.3	-0.1	57.90	2.13	-0.03	0.0	0.1	3.28	71.5	0.00
2479	-10	6	0.3	-0.1	57.90	2.13	-0.03	0.0	0.1	3.26	71.5	0.00
2482	-10	9	0.3	-0.1	57.90	2.15	-0.03	0.0	0.1	3.27	71.6	0.00
2506	-10	12	0.3	0.0	57.90	2.32	-0.04	0.1	0.2	3.29	71.4	0.00
2442	0	-6	0.0	0.0	57.90	0.00	-0.03	0.0	-0.1	3.10	71.6	0.00
2526	0	-6	0.3	-0.1	57.90	-0.58	-0.03	0.0	0.0	3.18	71.5	0.00
2458	0	0	0.3	0.0	57.90	-0.51	-0.03	0.0	0.0	3.22	71.6	0.00
2476	0	6	0.3	-0.1	57.90	-0.60	-0.03	0.0	0.0	3.21	71.6	0.00
2485	0	9	0.3	-0.1	57.90	-0.56	-0.03	0.1	0.0	3.22	71.6	0.00
2503	0	12	0.3	0.0	57.90	-0.58	-0.03	0.1	0.1	3.20	71.5	0.00
2523	10	-6	0.3	-0.1	57.90	-3.42	-0.03	0.0	0.0	3.18	71.5	0.00
2464	10	0	0.3	-0.1	57.90	-3.29	-0.03	0.1	0.0	3.20	71.6	0.00
2473	10	6	0.3	-0.1	57.90	-3.22	-0.03	0.1	0.0	3.21	71.6	0.00
2488	10	9	0.3	-0.2	57.90	-3.33	-0.03	0.2	0.0	3.23	71.6	0.00
2489	10	9	0.3	-0.1	57.90	-3.24	-0.03	0.1	0.0	3.20	71.6	0.00
2510	10	12	0.4	-0.1	57.90	-3.45	-0.03	0.1	0.1	3.22	71.5	0.00
2520	20	-6	0.3	-0.1	57.90	-4.90	-0.03	0.1	0.0	3.14	71.5	0.00
2467	20	0	0.3	-0.1	57.90	-5.03	-0.03	0.0	0.0	3.13	71.5	0.00
2518	20	0	0.3	-0.1	57.90	-4.91	-0.03	0.1	0.0	3.14	71.5	0.00
2470	20	6	0.3	-0.1	57.90	-5.01	-0.03	0.1	0.0	3.14	71.5	0.00
2516	20	6	0.3	-0.0	57.90	-4.95	-0.03	0.0	0.1	3.16	71.5	0.00
2492	20	9	0.3	-0.1	57.90	-5.04	-0.03	0.1	0.0	3.13	71.5	0.00
2513	20	12	0.4	-0.1	57.90	-4.94	-0.03	0.1	0.1	3.17	71.5	0.00
SPEED = 12.5 knots												
2530	-10	-6	2.4	-1.5	57.90	2.32	-0.04	-5.3	0.4	3.70	71.7	4.97
2462	-10	0	2.6	0.1	57.90	1.95	-0.05	-2.0	0.5	3.80	71.5	5.00
2480	-10	6	2.9	1.3	57.90	1.66	-0.06	-0.0	0.7	3.91	71.5	4.99
2483	-10	9	3.1	2.1	57.90	1.53	-0.06	1.0	0.7	4.01	71.5	4.96
2507	-10	12	3.5	3.5	57.90	1.55	-0.07	2.1	1.0	4.20	71.4	4.99
2527	0	-6	2.3	-1.8	57.90	-0.39	-0.04	-5.8	0.3	3.66	71.7	4.97
2459	0	0	2.6	0.0	57.90	-0.48	-0.05	-2.1	0.4	3.74	71.6	5.01
2477	0	6	2.8	1.1	57.90	-0.67	-0.05	0.1	0.6	3.86	71.5	4.94
2486	0	9	3.0	1.8	57.90	-0.70	-0.05	1.1	0.6	3.91	71.6	4.96
2504	0	12	3.2	2.8	57.90	-0.78	-0.06	2.4	0.7	4.03	71.5	4.93
2524	10	-6	2.4	-2.0	57.90	-3.16	-0.04	-5.7	0.3	3.65	71.7	4.98
2465	10	0	2.6	-0.2	57.90	-3.06	-0.04	-2.1	0.4	3.72	71.6	4.97
2474	10	6	2.8	1.2	57.90	-3.03	-0.05	-0.0	0.5	3.82	71.5	4.97
2490	10	9	2.9	1.9	57.90	-3.05	-0.05	0.9	0.5	3.84	71.6	4.96
2511	10	12	3.1	2.9	57.90	-3.21	-0.06	2.0	0.7	3.93	71.5	4.98

TABLE 9.2

BARE HULL RESULTS, L/R = 0.206, WITHOUT AIR TARES
Displacement 155 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	SKWL inch	Speed fps
SPEED = 12.5 knots												
2521	20	-6	2.4	-1.9	57.90	-4.75	-0.04	-5.7	0.3	3.62	71.7	4.97
2468	20	0	2.5	-0.1	57.90	-4.93	-0.04	-2.4	0.4	3.64	71.6	4.96
2471	20	6	2.8	1.5	57.90	-4.97	-0.05	-0.6	0.6	3.75	71.4	4.98
2493	20	9	3.0	2.5	57.90	-5.06	-0.05	-0.0	0.6	3.82	71.4	5.00
2514	20	12	3.1	3.6	57.90	-4.96	-0.05	0.8	0.7	3.90	71.5	4.98
SPEED = 35 knots												
2531	-10	-6	8.4	-12.0	57.90	-0.12	-0.14	-12.0	3.0	4.34	66.9	13.94
2463	-10	0	8.4	0.4	57.90	0.62	-0.13	-6.8	2.7	4.26	67.4	13.93
2481	-10	6	9.4	14.7	57.90	0.05	-0.16	-5.8	3.5	4.77	66.3	13.92
2484	-10	9	10.3	23.0	57.90	-0.54	-0.19	-9.0	4.3	5.28	64.4	13.91
2508	-10	12	11.2	31.6	57.90	-1.15	-0.24	-13.2	5.4	5.87	61.4	13.95
2528	0	-6	9.0	-15.2	57.90	-1.74	-0.13	-21.9	2.5	4.24	67.9	13.89
2460	0	0	8.2	-0.9	57.90	-1.34	-0.13	-10.1	2.5	4.12	67.8	13.91
2478	0	6	8.7	12.6	57.90	-1.06	-0.16	-7.1	3.3	4.56	66.3	13.89
2487	0	9	9.2	19.5	57.90	-1.11	-0.18	-9.4	3.8	4.83	64.9	13.86
2505	0	12	9.9	26.7	57.90	-1.10	-0.21	-12.1	4.5	5.16	62.8	13.91
2525	10	-6	9.9	-18.1	57.90	-3.30	-0.12	-28.7	2.4	4.30	68.4	13.93
2466	10	0	8.7	-2.1	57.90	-3.15	-0.11	-12.2	2.0	3.91	68.5	13.89
2475	10	6	8.4	11.6	57.90	-2.78	-0.13	-7.2	2.7	4.16	67.2	13.94
2491	10	9	8.7	18.3	57.90	-2.27	-0.14	-6.6	3.0	4.32	66.5	13.94
2512	10	12	8.6	23.2	57.90	-1.78	-0.17	-9.6	3.6	4.42	64.3	13.98
2522	20	-6	10.3	-16.3	57.90	-5.24	-0.13	-23.8	2.9	4.43	67.4	13.96
2469	20	0	9.0	-1.5	57.90	-5.44	-0.11	-14.4	2.3	3.98	68.0	13.92
2519	20	0	9.0	-1.7	57.90	-5.24	-0.11	-14.5	2.3	3.99	68.0	13.92
2472	20	6	8.6	12.6	57.90	-4.89	-0.12	-8.9	2.4	3.93	67.6	13.96
2517	20	6	8.7	12.2	57.90	-4.71	-0.12	-8.7	2.4	3.94	67.5	13.91
2494	20	9	8.5	19.9	57.90	-4.29	-0.12	-7.9	2.6	3.97	67.2	13.96
2515	20	12	8.1	23.7	57.90	-3.25	-0.13	-7.6	2.8	3.93	66.2	13.89

TABLE 10.1

APPENDED HULL RESULTS, L/R = 0
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	SKWL inch	Speed fps
SPEED = 0 knots												
1111	0	0	0.3	0.0	50.43	-0.02	-0.02	0.1	-0.3	2.82	71.7	0.00
1209	0	0	0.3	0.0	50.43	-0.11	-0.02	0.1	-0.3	2.83	71.6	0.00
1215	0	0	0.3	0.0	50.43	-0.10	-0.02	0.1	-0.3	2.81	71.6	0.00
1114	0	6	0.3	0.0	50.43	-0.01	-0.02	0.1	-0.3	2.82	71.7	0.00
1219	0	6	0.3	0.1	50.43	-0.04	-0.02	0.1	-0.3	2.85	71.7	0.00
1117	0	9	0.3	0.0	50.43	-0.01	-0.02	0.1	-0.3	2.80	71.6	0.00
1222	0	9	0.2	0.1	50.43	-0.07	-0.02	0.1	-0.3	2.84	71.6	0.00
1120	0	12	0.3	0.0	50.43	-0.01	-0.02	0.1	-0.3	2.86	71.7	0.00
1225	0	12	0.3	0.1	50.43	-0.05	-0.02	0.1	-0.3	2.83	71.6	0.00
1123	10	0	0.3	0.0	50.43	-2.64	-0.02	0.1	-0.2	2.90	71.6	0.00
1228	10	0	0.3	0.0	50.43	-2.74	-0.02	0.1	-0.2	2.84	71.5	0.00
1126	10	6	0.3	0.0	50.43	-2.66	-0.02	0.1	-0.2	2.88	71.6	0.00
1231	10	6	0.2	0.0	50.43	-2.71	-0.02	0.1	-0.2	2.88	71.6	0.00
1129	10	9	0.3	0.0	50.43	-2.65	-0.02	0.1	-0.2	2.92	71.6	0.00
1234	10	9	0.2	0.0	50.43	-2.72	-0.02	0.1	-0.2	2.89	71.6	0.00
1132	10	12	0.3	0.0	50.43	-2.66	-0.02	0.1	-0.2	2.89	71.6	0.00
1237	10	12	0.3	0.1	50.43	-2.70	-0.02	0.1	-0.2	2.86	71.5	0.00
1137	20	0	0.3	-0.1	50.43	-4.17	-0.02	0.1	-0.2	2.86	71.4	0.00
1240	20	0	0.3	0.0	50.43	-4.14	-0.02	0.1	-0.2	2.85	71.4	0.00
1252	20	3	0.2	0.0	50.43	-4.15	-0.02	0.2	-0.2	2.81	71.4	0.00
1140	20	6	0.3	0.0	50.43	-4.05	-0.02	0.1	-0.2	2.86	71.4	0.00
1243	20	6	0.2	0.0	50.43	-4.14	-0.02	0.1	-0.2	2.85	71.4	0.00
1143	20	9	0.3	0.0	50.43	-4.04	-0.02	0.1	-0.2	2.87	71.4	0.00
1246	20	9	0.2	0.1	50.43	-4.13	-0.02	0.1	-0.2	2.85	71.4	0.00
1146	20	12	0.3	0.0	50.43	-4.06	-0.02	0.1	-0.2	2.83	71.4	0.00
1211	20	12	0.3	0.0	50.43	-4.17	-0.02	0.1	-0.1	2.83	71.4	0.00
1249	20	12	0.3	0.0	50.43	-4.14	-0.02	0.1	-0.2	2.84	71.4	0.00
SPEED = 12.5 knots												
1112	0	0	2.2	0.0	50.43	0.00	-0.03	0.2	0.0	3.23	71.6	4.98
1210	0	0	2.2	0.0	50.43	-0.14	-0.03	0.2	0.0	3.22	71.6	4.98
1216	0	0	2.2	0.0	50.43	-0.10	-0.03	0.2	0.0	3.22	71.6	4.98
1115	0	6	2.3	1.4	50.43	-0.21	-0.03	1.6	0.0	3.27	71.7	4.98
1220	0	6	2.4	1.5	50.43	-0.26	-0.03	1.7	0.0	3.27	71.6	4.98
1118	0	9	2.4	2.4	50.43	-0.28	-0.03	3.0	0.0	3.33	71.7	4.98
1223	0	9	2.3	2.4	50.43	-0.40	-0.03	3.1	0.0	3.29	71.7	4.97
1121	0	12	2.4	3.6	50.43	-0.27	-0.03	5.1	0.0	3.35	71.8	4.98
1226	0	12	2.4	3.4	50.43	-0.43	-0.03	5.0	0.0	3.33	71.8	4.98
1124	10	0	2.2	-0.1	50.43	-2.45	-0.03	0.0	0.1	3.30	71.6	4.98
1229	10	0	2.2	0.0	50.43	-2.56	-0.03	0.1	0.1	3.24	71.5	4.97
1127	10	6	2.4	1.5	50.43	-2.66	-0.03	1.2	0.1	3.34	71.6	4.98
1232	10	6	2.3	1.5	50.43	-2.75	-0.03	1.2	0.1	3.29	71.5	4.97

TABLE 10.2

APPENDED HULL RESULTS, L/R = 0
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	SKWL inch	Speed fps
SPEED = 12.5 knots												
1130	10	9	2.4	2.3	50.43	-2.75	-0.03	2.4	0.1	3.34	71.6	4.98
1235	10	9	2.3	2.3	50.43	-2.83	-0.03	2.4	0.1	3.32	71.6	4.98
1133	10	12	2.4	3.3	50.43	-2.74	-0.03	4.2	0.0	3.37	71.7	4.98
1238	10	12	2.4	3.3	50.43	-2.85	-0.03	4.3	0.0	3.34	71.7	4.98
1138	20	0	2.2	-0.1	50.43	-4.02	-0.03	-0.3	0.2	3.23	71.3	4.97
1241	20	0	2.2	-0.1	50.43	-4.03	-0.03	-0.2	0.2	3.20	71.3	4.98
1253	20	3	2.2	0.7	50.43	-4.11	-0.03	0.3	0.2	3.22	71.3	4.97
1141	20	6	2.4	1.6	50.43	-4.16	-0.03	0.6	0.2	3.29	71.3	4.98
1244	20	6	2.3	1.6	50.43	-4.25	-0.03	0.6	0.2	3.26	71.3	4.98
1144	20	9	2.4	2.5	50.43	-4.26	-0.03	1.4	0.2	3.33	71.4	4.98
1247	20	9	2.4	2.5	50.43	-4.35	-0.03	1.5	0.2	3.30	71.4	4.98
1147	20	12	2.5	3.5	50.43	-4.36	-0.03	2.8	0.2	3.35	71.5	4.97
1250	20	12	2.4	3.5	50.43	-4.48	-0.03	2.9	0.2	3.33	71.5	4.97
SPEED = 35 knots												
1113	0	0	7.8	0.5	50.43	-0.02	-0.09	0.7	1.7	3.36	68.1	13.93
1217	0	0	7.9	0.3	50.43	-0.13	-0.10	0.7	1.8	3.37	68.0	13.95
1218	0	0	7.9	0.3	50.43	-0.11	-0.10	0.7	1.8	3.39	68.0	13.94
1116	0	6	8.6	13.3	50.43	0.03	-0.12	-1.7	2.4	3.71	67.0	13.92
1221	0	6	8.6	14.0	50.43	0.14	-0.12	-2.2	2.4	3.72	66.9	13.94
1119	0	9	9.3	21.1	50.43	0.24	-0.14	-5.7	2.9	4.00	66.1	13.97
1224	0	9	9.2	21.5	50.43	0.52	-0.14	-5.8	2.9	4.01	66.0	13.93
1122	0	12	10.1	29.0	50.43	0.85	-0.16	-9.1	3.5	4.33	64.5	13.93
1227	0	12	10.0	29.1	50.43	1.18	-0.16	-9.2	3.5	4.29	64.2	13.94
1125	10	0	8.1	-0.7	50.43	-2.18	-0.10	-1.9	1.9	3.46	67.9	13.94
1136	10	0	8.1	-0.8	50.43	-2.11	-0.10	-1.9	1.9	3.43	67.9	13.93
1230	10	0	8.1	-0.5	50.43	-2.20	-0.10	-1.8	1.9	3.41	67.7	13.94
1128	10	6	8.2	12.9	50.43	-1.68	-0.12	-4.1	2.4	3.64	66.7	13.93
1135	10	6	8.2	12.9	50.43	-1.68	-0.12	-4.1	2.4	3.64	66.8	13.92
1233	10	6	8.3	13.5	50.43	-1.52	-0.12	-4.4	2.4	3.64	66.6	13.92
1131	10	9	8.6	18.8	50.43	-1.20	-0.14	-8.9	3.0	3.88	64.8	13.94
1236	10	9	8.5	19.3	50.43	-0.92	-0.14	-9.0	3.0	3.81	64.4	13.94
1134	10	12	9.0	23.8	50.43	-0.51	-0.15	-10.9	3.2	3.89	63.6	13.95
1239	10	12	9.0	24.4	50.43	-0.14	-0.15	-11.0	3.2	3.85	63.3	13.92
1139	20	0	8.5	-1.3	50.43	-3.76	-0.10	-2.0	2.1	3.53	67.3	13.94
1242	20	0	8.6	-1.0	50.43	-3.69	-0.10	-1.9	2.1	3.49	67.3	13.95
1254	20	3	8.4	6.3	50.43	-3.76	-0.11	-3.7	2.3	3.49	66.8	13.93
1142	20	6	8.6	14.4	50.43	-3.50	-0.13	-7.2	2.7	3.74	65.8	13.92
1245	20	6	8.5	14.8	50.43	-3.26	-0.13	-7.3	2.7	3.66	65.6	13.95
1145	20	9	8.1	20.2	50.43	-3.02	-0.14	-11.6	3.2	3.76	63.0	13.94
1248	20	9	8.1	20.9	50.43	-2.66	-0.14	-11.7	3.2	3.73	62.7	13.92
1148	20	12	7.9	24.0	50.43	-2.37	-0.14	-12.3	3.1	3.53	62.4	13.92
1214	20	12	8.0	24.9	50.43	-1.96	-0.14	-12.5	3.1	3.51	62.1	13.94
1251	20	12	8.0	25.0	50.43	-1.96	-0.14	-12.7	3.1	3.53	62.1	13.93

TABLE 11.1

APPENDED HULL RESULTS, L/R = 0.206, WITHOUT AIR TARES
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	SKWL inch	Speed fps
SPEED = 0 knots												
2274	-10	-6	0.2	-0.1	50.43	2.13	-0.03	-0.1	0.0	3.00	71.3	0.00
2216	-10	0	0.2	-0.1	50.43	2.12	-0.03	0.0	0.0	2.95	71.3	0.00
2241	-10	6	0.2	-0.1	50.43	2.18	-0.03	0.1	0.0	3.01	71.3	0.00
2251	-10	9	0.3	-0.1	50.43	2.13	-0.03	0.1	0.0	3.03	71.3	0.00
2271	-10	12	0.3	-0.1	50.43	2.11	-0.03	0.1	0.0	3.04	71.3	0.00
2280	0	-6	0.1	-0.1	50.43	-0.53	-0.03	0.1	-0.1	2.94	71.5	0.00
2213	0	0	0.1	-0.2	50.43	-0.54	-0.03	0.0	-0.1	2.89	71.3	0.00
2245	0	6	0.1	-0.1	50.43	-0.48	-0.03	0.0	-0.1	2.95	71.4	0.00
2248	0	9	0.2	-0.1	50.43	-0.49	-0.03	0.1	-0.1	2.95	71.4	0.00
2267	0	12	0.3	-0.1	50.43	-0.51	-0.03	0.0	-0.1	2.96	71.4	0.00
2283	10	-6	0.2	-0.1	50.43	-3.11	-0.03	0.1	-0.1	2.92	71.4	0.00
2228	10	0	0.3	0.1	50.43	-3.64	-0.03	0.1	-0.1	2.88	71.3	0.00
2238	10	6	0.2	-0.1	50.43	-3.09	-0.03	0.1	0.0	2.95	71.3	0.00
2254	10	9	0.2	-0.1	50.43	-3.14	-0.03	0.1	0.0	2.96	71.4	0.00
2264	10	12	0.2	-0.1	50.43	-3.18	-0.03	0.1	-0.1	2.95	71.4	0.00
2286	20	-6	0.2	-0.1	50.43	-4.53	-0.02	0.1	-0.1	2.83	71.4	0.00
2232	20	0	0.2	-0.1	50.43	-4.53	-0.02	0.0	-0.1	2.80	71.2	0.00
2235	20	6	0.2	-0.1	50.43	-4.47	-0.02	0.1	-0.1	2.82	71.2	0.00
2257	20	9	0.3	-0.1	50.43	-4.55	-0.02	0.1	-0.1	2.87	71.3	0.00
2261	20	12	0.2	-0.1	50.43	-4.51	-0.02	0.1	-0.1	2.86	71.3	0.00
SPEED = 12.5 knots												
2278	-10	-6	2.0	-1.3	50.43	2.12	-0.04	-4.7	0.2	3.40	71.6	4.98
2276	-10	-3	2.1	-0.0	50.43	1.92	-0.04	-2.4	0.3	3.46	71.4	4.96
2217	-10	0	2.2	0.2	50.43	1.77	-0.04	-2.5	0.4	3.42	71.3	4.99
2242	-10	6	2.5	1.6	50.43	1.41	-0.05	-1.3	0.6	3.61	71.2	4.98
2252	-10	9	2.7	2.4	50.43	1.19	-0.05	-0.6	0.6	3.72	71.3	4.98
2272	-10	12	3.0	3.6	50.43	0.95	-0.06	0.2	0.7	3.82	71.3	4.98
2281	0	-6	2.1	-1.6	50.43	-0.39	-0.03	-5.3	0.1	3.41	71.7	4.98
2214	0	0	2.1	0.1	50.43	-0.70	-0.04	-2.5	0.3	3.38	71.3	4.96
2246	0	6	2.3	1.3	50.43	-0.94	-0.04	-1.5	0.4	3.55	71.3	4.99
2249	0	9	2.6	2.2	50.43	-1.05	-0.05	-0.6	0.5	3.63	71.3	4.99
2268	0	12	2.6	2.9	50.43	-1.13	-0.05	0.0	0.5	3.68	71.4	4.99
2284	10	-6	2.2	-1.6	50.43	-2.91	-0.03	-5.5	0.1	3.40	71.6	4.98
2229	10	0	2.3	0.3	50.43	-3.56	-0.04	-2.6	0.3	3.39	71.3	4.96
2239	10	6	2.4	1.6	50.43	-3.31	-0.05	-1.5	0.5	3.53	71.2	4.98
2243	10	6	2.4	1.6	50.43	1.42	-0.05	-1.3	0.5	3.60	71.2	4.95
2255	10	9	2.5	2.3	50.43	-3.36	-0.05	-0.9	0.5	3.60	71.3	5.00
2265	10	12	2.5	3.1	50.43	-3.45	-0.05	-0.1	0.5	3.63	71.4	4.97

TABLE 11.2

APPENDED HULL RESULTS, L/R = 0.206, WITHOUT AIR TARES
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	SKWL inch	Speed fps
SPEED = 12.5 knots												
2287	20	-6	2.1	-1.6	50.43	-4.55	-0.03	-5.3	0.1	3.31	71.5	4.98
2233	20	0	2.2	0.1	50.43	-4.68	-0.04	-2.9	0.3	3.32	71.2	4.98
2236	20	6	2.4	1.8	50.43	-4.92	-0.05	-1.8	0.5	3.45	71.1	4.99
2258	20	9	2.6	2.8	50.43	-5.08	-0.05	-1.6	0.6	3.56	71.1	4.98
2262	20	12	2.5	3.7	50.43	-5.12	-0.05	-1.0	0.5	3.58	71.2	4.98
SPEED = 35 knots												
2279	-10	-6	7.8	-11.1	50.43	0.70	-0.13	-9.0	2.6	4.01	67.3	13.91
2277	-10	-3	7.9	-0.3	50.43	0.09	-0.12	-9.3	2.3	3.89	67.7	13.90
2218	-10	0	7.5	1.5	50.43	-0.14	-0.12	-9.3	2.3	3.84	67.6	13.89
2253	-10	9	10.0	22.8	50.43	-1.67	-0.12	-6.6	2.5	4.25	68.1	13.91
2273	-10	12	10.9	33.0	50.43	-2.44	-0.16	-9.9	3.4	4.82	66.9	13.89
2282	0	-6	8.4	-13.7	50.43	-1.01	-0.12	-17.5	2.3	3.98	68.0	13.96
2215	0	0	7.3	0.3	50.43	-2.10	-0.11	-12.2	2.2	3.72	67.7	13.88
2247	0	6	8.5	14.0	50.43	-3.35	-0.14	-14.5	3.0	4.23	66.5	13.95
2250	0	9	8.8	18.0	50.43	-2.35	-0.13	-7.4	2.7	4.13	67.3	13.97
2269	0	12	10.2	27.5	50.43	-2.12	-0.09	2.9	1.6	3.85	69.6	13.90
2285	10	-6	9.2	-16.1	50.43	-2.31	-0.11	-22.9	2.1	3.99	68.5	13.94
2230	10	0	7.7	-0.9	50.43	-4.13	-0.11	-15.0	2.1	3.71	68.0	13.85
2240	10	6	8.0	13.4	50.43	-4.82	-0.13	-15.3	2.8	4.01	66.5	13.94
2244	10	6	8.9	16.1	50.43	-2.31	-0.14	-12.6	3.0	4.35	66.8	13.91
2256	10	9	8.2	15.8	50.43	-3.47	-0.10	-6.7	2.0	3.67	68.0	13.94
2266	10	12	8.1	21.4	50.43	-3.18	-0.12	-7.9	2.3	3.74	67.5	13.95
2289	20	-6	9.3	-14.5	50.43	-3.87	-0.10	-24.5	2.1	3.83	68.2	13.94
2234	20	0	8.1	-0.6	50.43	-5.61	-0.10	-14.1	2.1	3.69	67.8	13.91
2237	20	6	8.1	13.6	50.43	-6.58	-0.11	-14.4	2.4	3.77	67.0	13.92
2260	20	9	8.0	16.8	50.43	-5.19	-0.09	-9.0	1.7	3.40	68.2	13.94
2263	20	12	7.7	22.4	50.43	-4.72	-0.08	-5.3	1.4	3.19	68.6	13.92

TABLE 12

RUDDER EFFECTIVENESS RESULTS, L/R = 0, WITHOUT AIR TARES
 Displacement 135 long tons
 Roll = Yaw = 0 deg

Run No.	Rudder δ deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	SKWL inch	Speed fps
SPEED = 0 knots											
1215	0	0.3	0.0	50.43	-0.10	-0.02	0.1	-0.3	2.81	71.6	0.00
1263	5	0.3	0.0	50.43	-0.08	-0.02	0.1	-0.3	2.87	71.7	0.00
1259	10	0.3	0.0	50.43	-0.09	-0.02	0.1	-0.3	2.88	71.7	0.00
1255	15	0.3	0.0	50.43	-0.07	-0.02	0.1	-0.3	2.84	71.7	0.00
SPEED = 12.5 knots											
1210	0	2.2	0.0	50.43	-0.14	-0.03	0.2	0.0	3.22	71.6	4.98
1265	5	2.3	0.4	50.43	-0.19	-0.03	-0.6	0.0	3.21	71.6	4.98
1261	10	2.3	0.6	50.43	-0.24	-0.03	-1.0	0.0	3.23	71.6	4.98
1256	15	2.4	0.7	50.43	-0.28	-0.02	-1.3	-0.3	3.07	71.9	4.97
SPEED = 35 knots											
1217	0	7.9	0.3	50.43	-0.13	-0.10	0.7	1.8	3.37	68.0	13.95
1264	5	8.1	2.0	50.43	-1.00	-0.10	-3.8	1.8	3.37	68.0	13.95
1260	10	8.3	2.8	50.43	-1.29	-0.10	-5.4	1.8	3.36	68.0	13.94
1262	10	8.3	2.8	50.43	-1.29	-0.10	-5.4	1.8	3.37	68.1	13.92
1257	15	9.5	3.8	50.43	-1.57	-0.03	-8.0	0.0	2.77	71.0	13.94
1258	15	9.4	3.8	50.43	-1.57	-0.03	-7.9	0.0	2.77	71.0	13.94

TABLE 13

BARE HULL STATIC ROLL RESULTS, L/R = 0.206
Speed = 0 knots

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	SKWL inch	Speed fps
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DISPLACEMENT = 135 long tons

2554	-21	0	0.3	-0.1	50.43	3.75	-0.03	0.0	0.1	2.89	70.9	0.00
2553	-16	0	0.3	-0.1	50.43	3.17	-0.03	0.0	0.1	2.93	70.9	0.00
2552	-11	0	0.3	-0.1	50.43	2.34	-0.03	0.0	0.1	2.94	71.0	0.00
2551	-5	0	0.3	-0.1	50.43	0.91	-0.03	0.0	0.0	2.90	71.1	0.00
2550	-3	0	0.3	-0.1	50.43	0.34	-0.03	0.0	0.0	2.88	71.1	0.00
2555	0	0	0.2	-0.1	50.43	-0.51	-0.03	0.0	0.0	2.87	71.2	0.00
2543	0	0	0.3	-0.1	50.43	-0.49	-0.03	0.0	0.0	2.87	71.2	0.00
2544	5	0	0.3	-0.1	50.43	-1.65	-0.03	0.1	0.0	2.87	71.1	0.00
2546	10	0	0.3	-0.1	50.43	-3.14	-0.03	0.1	0.0	2.86	71.1	0.00
2545	10	0	0.3	-0.1	50.43	-3.31	-0.03	0.1	0.0	2.86	71.1	0.00
2547	16	0	0.3	-0.1	50.43	-4.12	-0.03	0.1	0.0	2.81	71.1	0.00
2548	20	0	0.2	-0.1	50.43	-4.48	-0.02	0.1	-0.1	2.75	71.1	0.00
2549	21	0	0.3	-0.1	50.43	-4.59	-0.02	0.0	-0.1	2.74	71.0	0.00

DISPLACEMENT = 155 long tons

2541	-20	0	0.3	-0.1	57.90	3.91	-0.03	0.0	0.3	3.27	71.2	0.00
2540	-16	0	0.3	-0.1	57.90	3.34	-0.03	0.0	0.2	3.27	71.3	0.00
2539	-10	0	0.3	-0.1	57.90	2.13	-0.03	0.0	0.2	3.24	71.4	0.00
2538	-5	0	0.3	-0.1	57.90	0.82	-0.03	0.0	0.1	3.20	71.5	0.00
2542	-3	0	0.3	-0.1	57.90	0.23	-0.03	0.1	0.1	3.19	71.5	0.00
2532	0	0	0.3	-0.1	57.90	-0.58	-0.03	0.0	0.0	3.18	71.5	0.00
2533	5	0	0.3	-0.1	57.90	-1.98	-0.03	0.1	0.0	3.17	71.5	0.00
2534	10	0	0.3	-0.1	57.90	-3.32	-0.03	0.1	0.1	3.18	71.5	0.00
2535	16	0	0.3	-0.1	57.90	-4.37	-0.03	0.0	0.1	3.16	71.5	0.00
2536	20	0	0.3	-0.1	57.90	-4.91	-0.03	0.1	0.1	3.12	71.4	0.00
2537	21	0	0.3	-0.1	57.90	-5.03	-0.03	0.1	0.0	3.11	71.4	0.00

TABLE 14.1

BARE HULL RESULTS, L/R = 0, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 knots											
1325	-20	-6	-0.2	-0.1	-50.43	5.20	-0.02	0.10	-0.4	2.81	0.00
1322	-10	-6	-0.3	0.0	-50.43	3.13	-0.02	0.10	-0.3	2.81	0.00
1328	0	-6	-0.3	-0.1	-50.43	-0.13	-0.02	0.10	-0.3	2.83	0.00
1272	0	0	-0.3	0.0	-50.43	-0.11	-0.02	0.10	-0.3	2.79	0.00
1318	0	3	-0.2	0.0	-50.43	-0.09	-0.03	0.10	-0.3	2.82	0.00
1275	0	6	-0.2	0.0	-50.43	-0.11	-0.03	0.10	-0.3	2.83	0.00
1278	0	9	-0.2	0.0	-50.43	-0.11	-0.03	0.10	-0.3	2.79	0.00
1316	0	11	-0.2	0.0	-50.43	-0.06	-0.03	0.10	-0.3	2.86	0.00
1281	0	12	-0.2	0.0	-50.43	-0.08	-0.03	0.10	-0.3	2.79	0.00
1314	0	12	-0.2	0.1	-50.43	-0.03	-0.03	0.10	-0.3	2.80	0.00
1285	10	0	-0.3	0.0	-50.43	-3.37	-0.03	0.10	-0.2	2.84	0.00
1320	10	3	-0.2	0.0	-50.43	-3.35	-0.04	0.10	-0.2	2.84	0.00
1289	10	6	-0.3	0.0	-50.43	-3.33	-0.03	0.10	-0.2	2.84	0.00
1292	10	9	-0.2	0.0	-50.43	-3.32	-0.04	0.10	-0.2	2.86	0.00
1295	10	12	-0.2	0.1	-50.43	-3.31	-0.04	0.10	-0.2	2.85	0.00
1298	20	0	-0.3	0.0	-50.43	-5.39	-0.03	0.11	-0.2	2.83	0.00
1312	20	3	-0.3	0.0	-50.43	-5.38	-0.03	0.11	-0.2	2.82	0.00
1301	20	6	-0.2	0.0	-50.43	-5.37	-0.04	0.10	-0.2	2.83	0.00
1306	20	9	-0.2	0.0	-50.43	-5.35	-0.04	0.10	-0.2	2.81	0.00
1309	20	12	-0.2	0.0	-50.43	-5.33	-0.04	0.10	-0.2	2.83	0.00
SPEED = 12.5 knots											
1326	-20	-6	-2.3	-1.0	-50.43	5.02	0.08	-1.25	0.0	3.21	4.98
1323	-10	-6	-2.3	-0.8	-50.43	2.94	0.08	-1.73	0.0	3.27	4.97
1329	0	-6	-2.3	-0.9	-50.43	-0.08	0.07	-1.90	0.1	3.29	4.98
1273	0	0	-2.1	0.0	-50.43	-0.10	0.07	0.10	0.0	3.20	4.97
1276	0	6	-2.3	1.0	-50.43	-0.15	0.07	2.50	0.1	3.28	4.98
1279	0	9	-2.3	1.7	-50.43	-0.13	0.08	4.20	0.0	3.27	4.98
1282	0	12	-2.4	2.9	-50.43	-0.02	0.09	6.40	0.0	3.31	4.97
1283	0	12	-2.4	2.8	-50.43	-0.05	0.09	6.30	0.0	3.33	4.98
1286	10	0	-2.2	-0.1	-50.43	-3.20	0.07	0.13	0.1	3.25	4.98
1290	10	6	-2.3	1.0	-50.43	-3.14	0.07	2.23	0.1	3.29	4.97
1293	10	9	-2.3	1.7	-50.43	-3.10	0.07	3.83	0.1	3.31	4.98
1296	10	12	-2.4	2.6	-50.43	-3.03	0.09	5.83	0.0	3.33	4.98
1299	20	0	-2.1	-0.1	-50.43	-5.24	0.05	-0.15	0.2	3.18	4.98
1302	20	6	-2.3	1.1	-50.43	-5.20	0.06	1.65	0.2	3.26	4.98
1307	20	9	-2.4	1.9	-50.43	-5.18	0.07	2.85	0.2	3.29	4.97
1310	20	12	-2.4	2.8	-50.43	-5.18	0.08	4.35	0.1	3.30	4.97

TABLE 14.2

BARE HULL RESULTS, L/R = 0, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 35 knots											
1327	-20	-6	-8.0	-9.6	-50.43	2.73	0.26	-0.16	2.0	3.43	13.94
1324	-10	-6	-7.7	-8.8	-50.43	0.41	0.26	-2.46	1.9	3.44	13.93
1274	0	0	-7.5	0.3	-50.43	-0.14	0.27	0.50	1.7	3.33	13.93
1319	0	3	-7.6	5.3	-50.43	0.93	0.26	3.68	1.9	3.45	13.93
1277	0	6	-8.1	11.1	-50.43	2.07	0.25	4.76	2.3	3.66	13.95
1280	0	9	-8.6	17.8	-50.43	3.56	0.24	3.22	2.8	3.97	13.93
1317	0	11	-9.0	22.3	-50.43	4.55	0.23	1.69	3.2	4.19	13.92
1284	0	12	-9.3	25.3	-50.43	5.16	0.22	0.37	3.5	4.32	13.94
1315	0	12	-9.2	25.1	-50.43	5.15	0.21	0.47	3.5	4.27	13.92
1287	10	0	-7.8	-0.5	-50.43	-2.93	0.27	-2.30	1.9	3.40	13.93
1288	10	0	-7.7	-0.5	-50.43	-2.93	0.27	-2.31	1.8	3.37	13.92
1321	10	3	-7.6	5.0	-50.43	-1.77	0.26	1.58	1.9	3.36	13.95
1291	10	6	-7.7	10.3	-50.43	-0.44	0.24	2.46	2.1	3.48	13.93
1294	10	9	-7.8	15.7	-50.43	1.29	0.18	0.03	2.8	3.73	13.92
1297	10	12	-8.1	20.3	-50.43	2.72	0.18	-0.19	3.0	3.73	13.95
1300	20	0	-8.2	-1.1	-50.43	-5.09	0.26	-2.70	2.1	3.46	13.93
1313	20	3	-8.1	4.9	-50.43	-4.16	0.27	-0.72	2.0	3.41	13.90
1305	20	6	-8.0	11.9	-50.43	-2.77	0.22	-1.65	2.4	3.54	13.93
1308	20	9	-7.5	18.0	-50.43	-1.12	0.15	-2.50	2.8	3.60	13.94
1311	20	12	-7.2	21.0	-50.43	0.17	0.14	-1.71	2.7	3.35	13.93

TABLE 15.1

BARE HULL RESULTS, L/R = 0.206, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 knots											
2198	-10	-6	-0.2	-0.2	-50.43	2.69	-0.06	0.00	0.0	2.99	0.00
2137	-10	0	-0.2	-0.1	-50.43	2.75	-0.06	-0.00	0.0	2.84	0.00
2153	-10	6	-0.2	-0.1	-50.43	2.92	-0.07	0.10	0.1	2.98	0.00
2175	-10	9	-0.2	-0.1	-50.43	2.72	-0.07	-0.00	0.1	2.99	0.00
2195	-10	12	-0.2	-0.1	-50.43	2.78	-0.07	0.10	0.1	3.00	0.00
2202	0	-6	-0.2	-0.2	-50.43	-0.52	-0.05	0.00	-0.1	2.92	0.00
2133	0	0	-0.2	0.0	-50.43	-0.37	-0.05	-0.10	-0.1	2.82	0.00
2135	0	0	-0.2	-0.1	-50.43	-0.43	-0.05	0.00	-0.1	2.81	0.00
2147	0	6	-0.2	-0.1	-50.43	-0.45	-0.05	0.10	-0.1	2.88	0.00
2146	0	6	-0.2	-0.1	-50.43	-0.46	-0.05	0.10	-0.1	2.88	0.00
2192	0	12	-0.2	-0.1	-50.43	-0.49	-0.06	0.10	0.0	2.94	0.00
2205	10	-6	-0.2	-0.1	-50.43	-3.74	-0.05	0.00	-0.1	2.90	0.00
2140	10	0	-0.2	-0.1	-50.43	-3.71	-0.05	0.00	-0.1	2.75	0.00
2156	10	6	-0.2	-0.1	-50.43	-3.49	-0.05	0.10	-0.1	2.93	0.00
2178	10	9	-0.2	-0.1	-50.43	-3.70	-0.06	0.10	0.0	2.92	0.00
2188	10	12	-0.2	-0.1	-50.43	-3.75	-0.06	0.10	0.0	2.93	0.00
2208	20	-6	-0.2	-0.2	-50.43	-5.86	-0.05	0.01	-0.1	2.78	0.00
2210	20	-6	-0.2	-0.1	-50.43	-5.84	-0.05	0.01	-0.1	2.78	0.00
2143	20	0	-0.2	-0.1	-50.43	-5.67	-0.05	0.01	-0.1	2.64	0.00
2160	20	6	-0.2	-0.1	-50.43	-5.76	-0.05	0.11	-0.1	2.83	0.00
2181	20	9	-0.1	-0.1	-50.43	-5.70	-0.06	0.10	-0.1	2.83	0.00
2184	20	12	-0.2	-0.1	-50.43	-5.73	-0.06	0.11	0.0	2.83	0.00
SPEED = 12.5 knots											
2201	-10	-6	-2.1	-1.4	-50.43	2.59	0.04	-4.60	0.3	3.42	4.98
2138	-10	0	-2.2	-0.1	-50.43	2.57	0.03	-1.82	0.4	3.34	4.98
2154	-10	6	-2.5	1.0	-50.43	2.56	0.03	0.05	0.6	3.58	4.97
2176	-10	9	-2.6	1.7	-50.43	2.21	0.03	0.84	0.7	3.69	4.99
2196	-10	12	-2.8	2.8	-50.43	2.20	0.04	1.81	0.8	3.82	4.98
2203	0	-6	-2.0	-1.7	-50.43	-0.43	0.04	-4.97	0.2	3.39	4.96
2134	0	0	-2.2	-0.1	-50.43	-0.29	0.04	-2.00	0.3	3.34	5.00
2150	0	6	-2.4	0.8	-50.43	-0.40	0.04	0.18	0.5	3.50	4.95
2151	0	6	-2.4	0.8	-50.43	-0.42	0.04	0.18	0.5	3.50	4.96
2173	0	9	-2.4	1.5	-50.43	-0.47	0.04	0.97	0.5	3.59	4.93
2193	0	12	-2.6	2.3	-50.43	-0.51	0.05	2.16	0.6	3.69	4.97
2206	10	-6	-2.1	-1.8	-50.43	-3.57	0.05	-4.94	0.2	3.37	4.98
2141	10	0	-2.2	-0.2	-50.43	-3.49	0.04	-1.97	0.3	3.24	4.99
2157	10	6	-2.4	0.8	-50.43	-3.24	0.04	0.11	0.5	3.48	4.98
2179	10	9	-2.5	1.6	-50.43	-3.37	0.05	0.80	0.5	3.55	4.98
2189	10	12	-2.6	2.3	-50.43	-3.38	0.06	1.89	0.5	3.61	4.98

TABLE 15.2

BARE HULL RESULTS, L/R = 0.206, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 12.5 knots											
2209	20	-6	-2.0	-1.7	-50.43	-5.84	0.05	-4.92	0.1	3.25	4.98
2144	20	0	-2.2	-0.1	-50.43	-5.61	0.04	-2.15	0.3	3.12	4.98
2161	20	6	-2.5	1.2	-50.43	-5.62	0.04	-0.57	0.5	3.41	4.98
2182	20	9	-2.4	2.1	-50.43	-5.62	0.04	-0.08	0.5	3.47	4.97
2186	20	12	-2.6	3.1	-50.43	-5.59	0.05	0.70	0.5	3.52	4.99
SPEED = 35 knots											
2199	-10	-6	-7.3	-10.3	-50.43	-0.16	0.18	-12.06	2.5	3.92	13.94
2139	-10	0	-7.4	0.3	-50.43	1.48	0.20	-5.89	2.4	3.71	14.02
2155	-10	6	-8.5	12.5	-50.43	1.82	0.21	-4.28	3.0	4.29	13.84
2177	-10	9	-9.0	20.6	-50.43	1.63	0.16	-8.39	3.8	4.77	13.90
2197	-10	12	-9.8	28.3	-50.43	1.46	0.13	-13.01	4.7	5.31	13.91
2204	0	-6	-7.7	-13.3	-50.43	-2.51	0.24	-20.51	2.2	3.88	13.86
2556	0	-6	-7.1	-13.0	-50.43	-2.56	0.19	-20.42	2.3	3.86	13.95
2136	0	0	-7.2	-1.2	-50.43	-1.17	0.22	-9.07	2.1	3.61	13.93
2557	0	0	-7.3	-0.8	-50.43	-1.22	0.21	-8.88	2.2	3.70	13.95
2152	0	6	-7.7	10.2	-50.43	-0.02	0.17	-5.53	2.8	4.09	13.84
2558	0	6	-7.7	10.6	-50.43	-0.08	0.17	-5.54	2.9	4.07	13.95
2174	0	9	-8.0	16.7	-50.43	0.37	0.14	-7.38	3.4	4.35	13.87
2194	0	12	-8.5	23.6	-50.43	0.83	0.12	-10.56	3.9	4.66	13.90
2559	0	12	-8.6	23.7	-50.43	0.81	0.12	-10.46	4.0	4.65	13.95
2212	10	-6	-8.8	-16.1	-50.43	-4.54	0.32	-25.75	2.1	3.96	13.94
2142	10	0	-7.8	-2.3	-50.43	-3.82	0.28	-11.46	1.8	3.38	13.94
2158	10	6	-7.4	8.9	-50.43	-2.32	0.21	-5.00	2.3	3.73	13.88
2180	10	9	-7.5	15.3	-50.43	-1.39	0.15	-6.05	2.9	3.96	13.94
2190	10	12	-7.7	19.8	-50.43	-0.57	0.14	-7.45	3.1	4.03	13.90
2191	10	12	-7.6	19.9	-50.43	-0.57	0.14	-7.46	3.1	4.03	13.92
2211	20	-6	-8.8	-13.3	-50.43	-7.01	0.25	-18.10	2.7	4.04	13.95
2145	20	0	-7.9	-1.7	-50.43	-6.13	0.26	-12.28	2.0	3.38	13.96
2162	20	6	-7.6	9.8	-50.43	-5.07	0.23	-7.03	2.1	3.55	13.91
2183	20	9	-7.5	16.5	-50.43	-3.96	0.20	-6.38	2.3	3.59	13.88
2187	20	12	-6.8	20.0	-50.43	-2.87	0.16	-5.77	2.3	3.45	13.94

TABLE 16.1

BARE HULL RESULTS, L/R = 0.412, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 knots											
3322	-10	-6	-0.2	0.0	-50.43	2.78	-0.06	0.10	0.0	2.92	0.00
3373	-10	-6	-0.2	0.0	-50.43	2.77	-0.06	-0.00	0.0	2.86	0.00
3319	-10	0	-0.2	0.0	-50.43	2.76	-0.06	-0.00	0.0	2.92	0.00
3337	-10	6	-0.2	-0.1	-50.43	2.76	-0.06	-0.00	0.0	2.86	0.00
3356	-10	9	-0.2	-0.0	-50.43	2.69	-0.06	-0.00	0.0	2.88	0.00
3359	-10	12	-0.2	0.0	-50.43	2.75	-0.06	0.10	0.0	2.88	0.00
3380	0	-6	-0.2	-0.1	-50.43	-0.49	-0.05	0.00	-0.1	2.81	0.00
3310	0	0	-0.1	-0.1	-50.43	-0.48	-0.06	0.00	-0.1	2.88	0.00
3334	0	6	-0.2	-0.0	-50.43	-0.47	-0.05	0.00	-0.1	2.80	0.00
3352	0	9	-0.2	-0.0	-50.43	-0.51	-0.05	0.00	-0.1	2.81	0.00
3363	0	12	-0.2	0.0	-50.43	-0.49	-0.05	0.10	-0.1	2.83	0.00
3387	10	-6	-0.1	0.0	-50.43	-3.74	-0.05	0.00	-0.2	2.77	0.00
3313	10	0	-0.2	0.0	-50.43	-3.70	-0.05	0.00	-0.1	2.86	0.00
3340	10	6	-0.2	-0.0	-50.43	-3.78	-0.05	0.00	-0.1	2.82	0.00
3349	10	9	-0.2	-0.0	-50.43	-3.72	-0.05	0.00	-0.1	2.82	0.00
3365	10	12	-0.2	0.0	-50.43	-3.78	-0.05	0.10	-0.1	2.82	0.00
3392	20	-6	-0.1	0.0	-50.43	-5.80	-0.05	0.00	-0.2	2.65	0.00
3316	20	0	-0.1	0.0	-50.43	-5.69	-0.06	0.10	-0.1	2.76	0.00
3343	20	6	-0.2	-0.1	-50.43	-5.69	-0.05	0.01	-0.1	2.72	0.00
3346	20	9	-0.2	-0.1	-50.43	-5.74	-0.05	0.11	-0.1	2.73	0.00
3368	20	12	-0.2	0.0	-50.43	-5.77	-0.05	0.10	-0.1	2.73	0.00
SPEED = 12.5 knots											
3323	-10	-6	-2.1	-2.2	-50.43	2.74	0.07	-8.78	0.0	3.29	4.98
3320	-10	0	-2.3	-0.1	-50.43	2.56	0.04	-4.03	0.4	3.42	4.98
3338	-10	6	-2.7	1.3	-50.43	2.22	0.04	-1.66	0.7	3.56	4.98
3357	-10	9	-2.9	2.2	-50.43	1.98	0.04	-1.28	0.9	3.72	4.98
3360	-10	12	-3.2	3.3	-50.43	1.83	0.04	-1.00	1.1	3.90	5.00
3381	0	-6	-2.0	-2.8	-50.43	-0.36	0.06	-9.45	0.0	3.20	4.97
3382	0	-6	-2.0	-2.8	-50.43	-0.33	0.06	-9.35	0.0	3.21	4.94
3311	0	0	-2.2	-0.4	-50.43	-0.39	0.04	-4.39	0.3	3.38	4.97
3335	0	6	-2.5	1.0	-50.43	-0.48	0.05	-1.62	0.5	3.46	4.99
3354	0	9	-2.7	1.7	-50.43	-0.55	0.04	-0.93	0.7	3.57	4.99
3362	0	12	-3.0	2.5	-50.43	-0.63	0.04	-0.35	0.9	3.73	4.99
3388	10	-6	-2.1	-3.0	-50.43	-3.57	0.07	-9.32	0.0	3.16	5.00
3314	10	0	-2.4	-0.3	-50.43	-3.46	0.06	-4.47	0.3	3.37	4.97
3341	10	6	-2.6	1.2	-50.43	-3.44	0.05	-1.89	0.6	3.44	4.98
3350	10	9	-2.8	2.0	-50.43	-3.30	0.05	-1.11	0.7	3.54	4.99
3366	10	12	-2.9	2.7	-50.43	-3.29	0.05	-0.42	0.7	3.59	4.98

TABLE 16.2

BARE HULL RESULTS, L/R = 0.412, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 12.5 knots											
3393	20	-6	-2.0	-2.2	-50.43	-5.88	0.06	-8.11	0.0	3.04	4.98
3317	20	0	-2.3	-0.2	-50.43	-5.72	0.05	-4.64	0.3	3.29	4.98
3344	20	6	-2.6	1.7	-50.43	-5.67	0.05	-2.57	0.5	3.33	4.99
3347	20	9	-2.9	2.7	-50.43	-5.68	0.05	-2.08	0.7	3.48	4.97
3369	20	12	-3.0	3.7	-50.43	-5.70	0.05	-1.80	0.8	3.55	4.97
SPEED = 35 knots											
3375	-10	-6	-7.7	-13.4	-50.43	-0.60	0.23	-30.40	2.2	3.79	14.00
3321	-10	0	-7.4	0.9	-50.43	0.42	0.18	-15.41	2.6	3.98	13.97
3339	-10	6	-8.6	16.6	-50.43	0.18	0.15	-16.39	3.7	4.52	13.98
3358	-10	9	-9.4	25.2	-50.43	-0.17	0.12	-20.82	4.5	5.01	14.01
3361	-10	12	-10.2	34.4	-50.43	-0.90	0.07	-27.70	5.6	5.60	14.00
3312	0	0	-7.4	-2.3	-50.43	-1.84	0.22	-20.55	2.2	3.75	13.86
3336	0	6	-7.9	12.8	-50.43	-1.10	0.16	-15.19	3.1	4.13	13.98
3355	0	9	-8.5	19.8	-50.43	-0.84	0.15	-17.86	3.6	4.38	13.88
3364	0	12	-8.9	27.3	-50.43	-0.58	0.11	-21.46	4.3	4.72	13.89
3315	10	0	-7.9	-4.9	-50.43	-3.89	0.33	-26.60	1.4	3.37	13.99
3342	10	6	-7.6	9.8	-50.43	-3.02	0.23	-14.32	2.2	3.56	13.98
3351	10	9	-7.7	16.3	-50.43	-1.98	0.19	-13.57	2.6	3.70	13.99
3367	10	12	-7.6	21.4	-50.43	-0.91	0.17	-13.88	2.8	3.75	14.01
3395	20	-6	-8.7	-10.3	-50.43	-7.65	0.25	-24.47	2.6	3.74	13.99
3318	20	0	-7.9	-2.5	-50.43	-6.65	0.28	-25.16	1.7	3.41	14.00
3345	20	6	-7.6	9.5	-50.43	-5.35	0.27	-15.92	1.6	3.14	13.93
3348	20	9	-7.4	15.5	-50.43	-4.25	0.27	-13.14	1.5	3.08	14.00
3371	20	12	-7.2	20.7	-50.43	-2.97	0.27	-10.25	1.3	2.93	13.91

TABLE 17

SUPPLEMENTAL BARE HULL RESULTS, L/R = 0.412, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 to 28 knots											
3428	0	-5	-0.1	-0.1	-50.43	-0.49	-0.06	0.00	-0.1	2.82	0.00
3429	0	-5	-2.1	-2.2	-50.43	-0.39	0.07	-8.16	0.0	3.23	4.94
3434	0	-5	-3.2	-3.4	-50.43	-0.43	0.09	-13.13	0.5	3.63	5.98
3430	0	-5	-4.2	-4.5	-50.43	-0.60	0.08	-17.21	1.3	4.10	6.94
3431	0	-5	-5.5	-7.4	-50.43	-1.34	0.11	-23.74	1.9	4.16	9.05
3433	0	-5	-6.5	-12.8	-50.43	-1.57	0.24	-34.14	1.3	3.67	11.08
3406	-10	-6	-0.1	-0.1	-50.43	2.73	-0.07	0.00	0.0	2.82	0.00
3403	0	-6	-0.1	-0.1	-50.43	-0.51	-0.06	0.00	-0.1	2.74	0.00
3436	0	-6	-0.1	-0.1	-50.43	-0.55	-0.05	0.00	-0.2	2.81	0.00
3408	10	-6	-0.1	0.0	-50.43	-3.74	-0.06	0.00	-0.1	2.72	0.00
3391	20	-6	-0.1	0.0	-50.43	-5.78	-0.05	0.00	-0.2	2.64	0.00
3410	20	-6	-0.1	0.3	-50.43	-5.75	-0.04	0.10	-0.3	2.58	0.00
3441	0	-6	-0.6	-0.6	-50.43	-0.49	-0.02	-2.39	-0.2	2.92	2.92
3435	0	-6	-2.0	-2.7	-50.43	-0.46	0.06	-9.35	0.0	3.19	4.97
3440	0	-6	-3.1	-4.2	-50.43	-0.51	0.10	-15.32	0.4	3.62	5.99
3407	-10	-6	-4.3	-4.5	-50.43	2.31	0.08	-17.36	1.4	4.09	7.02
3405	0	-6	-4.3	-5.6	-50.43	-0.63	0.08	-20.08	1.4	4.05	7.03
3412	0	-6	-4.3	-5.6	-50.43	-0.63	0.09	-20.08	1.3	4.08	7.01
3437	0	-6	-4.3	-5.7	-50.43	-0.74	0.09	-20.18	1.3	4.13	7.06
3409	10	-6	-4.4	-6.0	-50.43	-3.87	0.10	-21.02	1.3	4.02	7.02
3411	20	-6	-4.7	-3.7	-50.43	-6.38	0.10	-16.61	1.4	3.93	7.02
3384	0	-6	-5.2	-7.9	-50.43	-1.16	0.09	-25.33	1.9	4.24	8.66
3438	0	-6	-5.6	-9.1	-50.43	-1.52	0.12	-27.01	1.9	4.19	9.06
3385	0	-6	-5.9	-12.9	-50.43	-1.48	0.18	-34.33	1.5	3.87	10.22
3390	10	-6	-6.5	-13.8	-50.43	-4.55	0.21	-34.84	1.6	3.82	10.42
3394	20	-6	-6.8	-8.9	-50.43	-6.95	0.19	-25.95	1.9	3.83	10.41

TABLE 18.1

BARE HULL RESULTS, L/R = 0.206, AXES A
Displacement 155 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 knots											
2529	-10	-6	-0.3	-0.1	-57.9	3.04	-0.07	-0.00	0.1	3.25	0.00
2461	-10	0	-0.3	-0.1	-57.9	2.82	-0.07	-0.00	0.1	3.28	0.00
2479	-10	6	-0.3	-0.1	-57.9	2.82	-0.07	-0.00	0.1	3.26	0.00
2482	-10	9	-0.3	-0.1	-57.9	2.84	-0.07	-0.00	0.1	3.27	0.00
2506	-10	12	-0.3	0.0	-57.9	3.01	-0.08	0.10	0.2	3.29	0.00
2442	0	-6	0.0	0.0	-57.9	0.00	-0.07	0.00	-0.1	3.10	0.00
2526	0	-6	-0.3	-0.1	-57.9	-0.59	-0.06	0.00	0.0	3.18	0.00
2458	0	0	-0.3	0.0	-57.9	-0.51	-0.06	0.00	0.0	3.22	0.00
2476	0	6	-0.3	-0.1	-57.9	-0.61	-0.06	0.00	0.0	3.21	0.00
2485	0	9	-0.3	-0.1	-57.9	-0.57	-0.06	0.10	0.0	3.22	0.00
2503	0	12	-0.3	0.0	-57.9	-0.58	-0.07	0.10	0.1	3.20	0.00
2523	10	-6	-0.3	-0.1	-57.9	-4.12	-0.06	0.01	0.0	3.18	0.00
2464	10	0	-0.3	-0.1	-57.9	-3.99	-0.06	0.11	0.0	3.20	0.00
2473	10	6	-0.3	-0.1	-57.9	-3.92	-0.06	0.11	0.0	3.21	0.00
2488	10	9	-0.3	-0.2	-57.9	-4.04	-0.06	0.21	0.0	3.23	0.00
2489	10	9	-0.3	-0.1	-57.9	-3.94	-0.06	0.11	0.0	3.20	0.00
2510	10	12	-0.4	-0.1	-57.9	-4.15	-0.07	0.11	0.1	3.22	0.00
2520	20	-6	-0.3	-0.1	-57.9	-6.27	-0.06	0.11	0.0	3.14	0.00
2467	20	0	-0.3	-0.1	-57.9	-6.40	-0.06	0.01	0.0	3.13	0.00
2518	20	0	-0.3	-0.1	-57.9	-6.28	-0.06	0.11	0.0	3.14	0.00
2470	20	6	-0.3	-0.1	-57.9	-6.38	-0.06	0.11	0.0	3.14	0.00
2516	20	6	-0.3	-0.0	-57.9	-6.32	-0.07	0.01	0.1	3.16	0.00
2492	20	9	-0.3	-0.1	-57.9	-6.41	-0.06	0.11	0.0	3.13	0.00
2513	20	12	-0.4	-0.1	-57.9	-6.31	-0.06	0.11	0.1	3.17	0.00
SPEED = 12.5 knots											
2530	-10	-6	-2.4	-1.5	-57.9	2.92	0.04	-5.30	0.4	3.70	4.97
2462	-10	0	-2.6	0.1	-57.9	2.65	0.04	-2.03	0.5	3.80	5.00
2480	-10	6	-2.9	1.3	-57.9	2.45	0.04	-0.06	0.7	3.91	4.99
2483	-10	9	-3.1	2.1	-57.9	2.36	0.05	0.92	0.7	4.01	4.96
2507	-10	12	-3.5	3.5	-57.9	2.48	0.05	2.09	1.0	4.20	4.99
2527	0	-6	-2.3	-1.8	-57.9	-0.51	0.04	-5.77	0.3	3.66	4.97
2459	0	0	-2.6	0.0	-57.9	-0.48	0.05	-2.10	0.4	3.74	5.01
2477	0	6	-2.8	1.1	-57.9	-0.59	0.04	0.08	0.6	3.86	4.94
2486	0	9	-3.0	1.8	-57.9	-0.58	0.06	1.07	0.6	3.91	4.96
2504	0	12	-3.2	2.8	-57.9	-0.59	0.06	2.35	0.7	4.03	4.93
2524	10	-6	-2.4	-2.0	-57.9	-3.99	0.05	-5.63	0.3	3.65	4.98
2465	10	0	-2.6	-0.2	-57.9	-3.77	0.05	-2.07	0.4	3.72	4.97
2474	10	6	-2.8	1.2	-57.9	-3.64	0.05	0.01	0.5	3.82	4.97
2490	10	9	-2.9	1.9	-57.9	-3.61	0.06	0.90	0.5	3.84	4.96
2511	10	12	-3.1	2.9	-57.9	-3.70	0.06	2.08	0.7	3.93	4.98

TABLE 18.2

BARE HULL RESULTS, L/R = 0.206, AXES A
Displacement 155 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 12.5 knots											
2521	20	-6	-2.4	-1.9	-57.9	-6.24	0.05	-5.61	0.3	3.62	4.97
2468	20	0	-2.5	-0.1	-57.9	-6.30	0.04	-2.34	0.4	3.64	4.96
2471	20	6	-2.8	1.5	-57.9	-6.24	0.04	-0.56	0.6	3.75	4.98
2493	20	9	-3.0	2.5	-57.9	-6.27	0.05	0.02	0.6	3.82	5.00
2514	20	12	-3.1	3.6	-57.9	-6.09	0.05	0.90	0.7	3.90	4.98
SPEED = 35 knots											
2531	-10	-6	-8.4	-12.0	-57.9	-0.23	0.17	-12.03	3.0	4.34	13.94
2463	-10	0	-8.4	0.4	-57.9	1.34	0.20	-6.91	2.7	4.26	13.93
2481	-10	6	-9.4	14.7	-57.9	1.74	0.18	-5.95	3.5	4.77	13.92
2484	-10	9	-10.3	23.0	-57.9	1.71	0.15	-9.27	4.3	5.28	13.91
2508	-10	12	-11.2	31.6	-57.9	1.69	0.10	-13.53	5.4	5.87	13.95
2528	0	-6	-9.0	-15.2	-57.9	-2.78	0.27	-21.87	2.5	4.24	13.89
2460	0	0	-8.2	-0.9	-57.9	-1.40	0.21	-10.08	2.5	4.12	13.91
2478	0	6	-8.7	12.6	-57.9	-0.19	0.16	-7.19	3.3	4.56	13.89
2487	0	9	-9.2	19.5	-57.9	0.24	0.14	-9.46	3.8	4.83	13.86
2505	0	12	-9.9	26.7	-57.9	0.73	0.10	-12.25	4.5	5.16	13.91
2525	10	-6	-9.9	-18.1	-57.9	-5.22	0.34	-28.49	2.4	4.30	13.93
2466	10	0	-8.7	-2.1	-57.9	-3.99	0.30	-12.05	2.0	3.91	13.89
2475	10	6	-8.4	11.6	-57.9	-2.69	0.20	-7.16	2.7	4.16	13.94
2491	10	9	-8.7	18.3	-57.9	-1.72	0.19	-6.61	3.0	4.32	13.94
2512	10	12	-8.6	23.2	-57.9	-0.91	0.12	-9.63	3.6	4.42	13.98
2522	20	-6	-10.3	-16.3	-57.9	-7.66	0.30	-23.49	2.9	4.43	13.96
2469	20	0	-9.0	-1.5	-57.9	-6.90	0.27	-14.16	2.3	3.98	13.92
2519	20	0	-9.0	-1.7	-57.9	-6.72	0.27	-14.25	2.3	3.99	13.92
2472	20	6	-8.6	12.6	-57.9	-5.44	0.24	-8.77	2.4	3.93	13.96
2517	20	6	-8.7	12.2	-57.9	-5.29	0.24	-8.56	2.4	3.94	13.91
2494	20	9	-8.5	19.9	-57.9	-4.37	0.21	-7.73	2.6	3.97	13.96
2515	20	12	-8.1	23.7	-57.9	-3.08	0.16	-7.53	2.8	3.93	13.89

TABLE 19.1

APPENDED HULL RESULTS, L/R = 0, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 knots											
1111	0	0	-0.3	0.0	-50.43	-0.02	-0.02	0.10	-0.3	2.82	0.00
1209	0	0	-0.3	0.0	-50.43	-0.11	-0.02	0.10	-0.3	2.83	0.00
1215	0	0	-0.3	0.0	-50.43	-0.10	-0.02	0.10	-0.3	2.81	0.00
1114	0	6	-0.3	0.0	-50.43	-0.01	-0.02	0.10	-0.3	2.82	0.00
1219	0	6	-0.3	0.1	-50.43	-0.03	-0.02	0.10	-0.3	2.85	0.00
1117	0	9	-0.3	0.0	-50.43	-0.01	-0.02	0.10	-0.3	2.80	0.00
1222	0	9	-0.2	0.1	-50.43	-0.06	-0.03	0.10	-0.3	2.84	0.00
1120	0	12	-0.3	0.0	-50.43	-0.01	-0.02	0.10	-0.3	2.86	0.00
1225	0	12	-0.3	0.1	-50.43	-0.04	-0.02	0.10	-0.3	2.83	0.00
1123	10	0	-0.3	0.0	-50.43	-3.24	-0.03	0.10	-0.2	2.90	0.00
1228	10	0	-0.3	0.0	-50.43	-3.34	-0.03	0.10	-0.2	2.84	0.00
1126	10	6	-0.3	0.0	-50.43	-3.26	-0.03	0.10	-0.2	2.88	0.00
1231	10	6	-0.2	0.0	-50.43	-3.31	-0.04	0.10	-0.2	2.88	0.00
1129	10	9	-0.3	0.0	-50.43	-3.25	-0.03	0.10	-0.2	2.92	0.00
1234	10	9	-0.2	0.0	-50.43	-3.32	-0.04	0.10	-0.2	2.89	0.00
1132	10	12	-0.3	0.0	-50.43	-3.26	-0.03	0.10	-0.2	2.89	0.00
1237	10	12	-0.3	0.1	-50.43	-3.30	-0.03	0.10	-0.2	2.86	0.00
1137	20	0	-0.3	-0.1	-50.43	-5.37	-0.03	0.11	-0.2	2.86	0.00
1240	20	0	-0.3	0.0	-50.43	-5.33	-0.03	0.11	-0.2	2.85	0.00
1252	20	3	-0.2	0.0	-50.43	-5.34	-0.04	0.20	-0.2	2.81	0.00
1140	20	6	-0.3	0.0	-50.43	-5.24	-0.03	0.11	-0.2	2.86	0.00
1243	20	6	-0.2	0.0	-50.43	-5.33	-0.04	0.10	-0.2	2.85	0.00
1143	20	9	-0.3	0.0	-50.43	-5.23	-0.03	0.11	-0.2	2.87	0.00
1246	20	9	-0.2	0.1	-50.43	-5.31	-0.04	0.10	-0.2	2.85	0.00
1146	20	12	-0.3	0.0	-50.43	-5.25	-0.03	0.11	-0.2	2.83	0.00
1211	20	12	-0.3	0.0	-50.43	-5.36	-0.04	0.11	-0.1	2.83	0.00
1249	20	12	-0.3	0.0	-50.43	-5.33	-0.03	0.11	-0.2	2.84	0.00
SPEED = 12.5 knots											
1112	0	0	-2.2	0.0	-50.43	0.00	0.08	0.20	0.0	3.23	4.98
1210	0	0	-2.2	0.0	-50.43	-0.14	0.08	0.20	0.0	3.22	4.98
1216	0	0	-2.2	0.0	-50.43	-0.10	0.08	0.20	0.0	3.22	4.98
1115	0	6	-2.3	1.4	-50.43	-0.11	0.08	1.60	0.0	3.27	4.98
1220	0	6	-2.4	1.5	-50.43	-0.16	0.09	1.70	0.0	3.27	4.98
1118	0	9	-2.4	2.4	-50.43	-0.11	0.09	3.00	0.0	3.33	4.98
1223	0	9	-2.3	2.4	-50.43	-0.23	0.08	3.10	0.0	3.29	4.97
1121	0	12	-2.4	3.6	-50.43	-0.02	0.09	5.10	0.0	3.35	4.98
1226	0	12	-2.4	3.4	-50.43	-0.20	0.09	5.00	0.0	3.33	4.98
1124	10	0	-2.2	-0.1	-50.43	-3.06	0.07	0.03	0.1	3.30	4.98
1229	10	0	-2.2	0.0	-50.43	-3.16	0.07	0.13	0.1	3.24	4.97
1127	10	6	-2.4	1.5	-50.43	-3.16	0.08	1.23	0.1	3.34	4.98
1232	10	6	-2.3	1.5	-50.43	-3.25	0.07	1.23	0.1	3.29	4.97

TABLE 19.2

APPENDED HULL RESULTS, L/R = 0, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 12.5 knots											
1130	10	9	-2.4	2.3	-50.43	-3.20	0.08	2.43	0.1	3.34	4.98
1235	10	9	-2.3	2.3	-50.43	-3.28	0.07	2.43	0.1	3.32	4.98
1133	10	12	-2.4	3.3	-50.43	-3.12	0.09	4.23	0.0	3.37	4.98
1238	10	12	-2.4	3.3	-50.43	-3.23	0.09	4.33	0.0	3.34	4.98
1138	20	0	-2.2	-0.1	-50.43	-5.22	0.05	-0.25	0.2	3.23	4.97
1241	20	0	-2.2	-0.1	-50.43	-5.23	0.05	-0.15	0.2	3.20	4.98
1253	20	3	-2.2	0.7	-50.43	-5.25	0.05	0.35	0.2	3.22	4.97
1141	20	6	-2.4	1.6	-50.43	-5.25	0.07	0.65	0.2	3.29	4.98
1244	20	6	-2.3	1.6	-50.43	-5.34	0.06	0.65	0.2	3.26	4.98
1144	20	9	-2.4	2.5	-50.43	-5.29	0.07	1.45	0.2	3.33	4.98
1247	20	9	-2.4	2.5	-50.43	-5.38	0.07	1.55	0.2	3.30	4.98
1147	20	12	-2.5	3.5	-50.43	-5.32	0.07	2.86	0.2	3.35	4.97
1250	20	12	-2.4	3.5	-50.43	-5.44	0.07	2.95	0.2	3.33	4.97
SPEED = 35 knots											
1113	0	0	-7.8	0.5	-50.43	0.01	0.29	0.70	1.7	3.36	13.93
1217	0	0	-7.9	0.3	-50.43	-0.11	0.29	0.70	1.8	3.37	13.95
1218	0	0	-7.9	0.3	-50.43	-0.09	0.29	0.70	1.8	3.39	13.94
1116	0	6	-8.6	13.3	-50.43	0.95	0.28	-1.75	2.4	3.71	13.92
1221	0	6	-8.6	14.0	-50.43	1.10	0.28	-2.25	2.4	3.72	13.94
1119	0	9	-9.3	21.1	-50.43	1.69	0.28	-5.79	2.9	4.00	13.97
1224	0	9	-9.2	21.5	-50.43	2.00	0.27	-5.89	2.9	4.01	13.93
1122	0	12	-10.1	29.0	-50.43	2.85	0.27	-9.25	3.5	4.33	13.93
1227	0	12	-10.0	29.1	-50.43	3.18	0.27	-9.35	3.5	4.29	13.94
1125	10	0	-8.1	-0.7	-50.43	-2.83	0.29	-1.80	1.9	3.46	13.94
1136	10	0	-8.1	-0.8	-50.43	-2.77	0.29	-1.80	1.9	3.43	13.93
1230	10	0	-8.1	-0.5	-50.43	-2.84	0.29	-1.70	1.9	3.41	13.94
1128	10	6	-8.2	12.9	-50.43	-1.41	0.25	-4.05	2.4	3.64	13.93
1135	10	6	-8.2	12.9	-50.43	-1.41	0.25	-4.05	2.4	3.64	13.92
1233	10	6	-8.3	13.5	-50.43	-1.21	0.25	-4.35	2.4	3.64	13.92
1131	10	9	-8.6	18.8	-50.43	-0.53	0.22	-8.88	3.0	3.88	13.94
1236	10	9	-8.5	19.3	-50.43	-0.22	0.21	-8.98	3.0	3.81	13.94
1134	10	12	-9.0	23.8	-50.43	0.50	0.22	-10.90	3.2	3.89	13.95
1239	10	12	-9.0	24.4	-50.43	0.91	0.22	-11.01	3.2	3.85	13.92
1139	20	0	-8.5	-1.3	-50.43	-5.03	0.28	-1.80	2.1	3.53	13.94
1242	20	0	-8.6	-1.0	-50.43	-4.94	0.29	-1.69	2.1	3.49	13.95
1254	20	3	-8.4	6.3	-50.43	-4.54	0.26	-3.52	2.3	3.49	13.93
1142	20	6	-8.6	14.4	-50.43	-3.76	0.23	-7.05	2.7	3.74	13.92
1245	20	6	-8.5	14.8	-50.43	-3.49	0.23	-7.16	2.7	3.66	13.95
1145	20	9	-8.1	20.2	-50.43	-2.90	0.15	-11.50	3.2	3.76	13.94
1248	20	9	-8.1	20.9	-50.43	-2.50	0.15	-11.60	3.2	3.73	13.92
1148	20	12	-7.9	24.0	-50.43	-2.01	0.15	-12.22	3.1	3.53	13.92
1214	20	12	-8.0	24.9	-50.43	-1.54	0.16	-12.42	3.1	3.51	13.94
1251	20	12	-8.0	25.0	-50.43	-1.53	0.16	-12.62	3.1	3.53	13.93

TABLE 20.1

APPENDED HULL RESULTS, L/R = 0.206, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 knots											
2274	-10	-6	-0.2	-0.1	-50.43	2.73	-0.06	-0.10	0.0	3.00	0.00
2216	-10	0	-0.2	-0.1	-50.43	2.72	-0.06	-0.00	0.0	2.95	0.00
2241	-10	6	-0.2	-0.1	-50.43	2.78	-0.06	0.10	0.0	3.01	0.00
2251	-10	9	-0.3	-0.1	-50.43	2.73	-0.05	0.10	0.0	3.03	0.00
2271	-10	12	-0.3	-0.1	-50.43	2.71	-0.05	0.10	0.0	3.04	0.00
2280	0	-6	-0.1	-0.1	-50.43	-0.54	-0.06	0.10	-0.1	2.94	0.00
2213	0	0	-0.1	-0.2	-50.43	-0.56	-0.06	0.00	-0.1	2.89	0.00
2245	0	6	-0.1	-0.1	-50.43	-0.49	-0.06	0.00	-0.1	2.95	0.00
2248	0	9	-0.2	-0.1	-50.43	-0.50	-0.05	0.10	-0.1	2.95	0.00
2267	0	12	-0.3	-0.1	-50.43	-0.52	-0.04	0.00	-0.1	2.96	0.00
2283	10	-6	-0.2	-0.1	-50.43	-3.72	-0.05	0.10	-0.1	2.92	0.00
2228	10	0	-0.3	0.1	-50.43	-4.24	-0.04	0.10	-0.1	2.88	0.00
2238	10	6	-0.2	-0.1	-50.43	-3.70	-0.06	0.10	0.0	2.95	0.00
2254	10	9	-0.2	-0.1	-50.43	-3.75	-0.06	0.10	0.0	2.96	0.00
2264	10	12	-0.2	-0.1	-50.43	-3.79	-0.05	0.10	-0.1	2.95	0.00
2286	20	-6	-0.2	-0.1	-50.43	-5.73	-0.05	0.11	-0.1	2.83	0.00
2232	20	0	-0.2	-0.1	-50.43	-5.73	-0.05	0.01	-0.1	2.80	0.00
2235	20	6	-0.2	-0.1	-50.43	-5.67	-0.05	0.11	-0.1	2.82	0.00
2257	20	9	-0.3	-0.1	-50.43	-5.75	-0.04	0.11	-0.1	2.87	0.00
2261	20	12	-0.2	-0.1	-50.43	-5.71	-0.05	0.11	-0.1	2.86	0.00
SPEED = 12.5 knots											
2278	-10	-6	-2.0	-1.3	-50.43	2.63	0.04	-4.70	0.2	3.40	4.98
2276	-10	-3	-2.1	-0.0	-50.43	2.52	0.04	-2.43	0.3	3.46	4.96
2217	-10	0	-2.2	0.2	-50.43	2.39	0.03	-2.53	0.4	3.42	4.99
2242	-10	6	-2.5	1.6	-50.43	2.12	0.03	-1.36	0.6	3.61	4.98
2252	-10	9	-2.7	2.4	-50.43	1.95	0.05	-0.68	0.6	3.72	4.98
2272	-10	12	-3.0	3.6	-50.43	1.80	0.06	0.19	0.7	3.82	4.98
2281	0	-6	-2.1	-1.6	-50.43	-0.50	0.06	-5.27	0.1	3.41	4.98
2214	0	0	-2.1	0.1	-50.43	-0.69	0.04	-2.50	0.3	3.38	4.96
2246	0	6	-2.3	1.3	-50.43	-0.85	0.04	-1.53	0.4	3.55	4.99
2249	0	9	-2.6	2.2	-50.43	-0.89	0.05	-0.64	0.5	3.63	4.99
2268	0	12	-2.6	2.9	-50.43	-0.93	0.06	0.04	0.5	3.68	4.99
2284	10	-6	-2.2	-1.6	-50.43	-3.62	0.06	-5.44	0.1	3.40	4.98
2229	10	0	-2.3	0.3	-50.43	-4.14	0.05	-2.58	0.3	3.39	4.96
2239	10	6	-2.4	1.6	-50.43	-3.81	0.04	-1.50	0.5	3.53	4.98
2243	10	6	-2.4	1.6	-50.43	0.92	0.04	-1.30	0.5	3.60	4.95
2255	10	9	-2.5	2.3	-50.43	-3.81	0.05	-0.91	0.5	3.60	5.00
2265	10	12	-2.5	3.1	-50.43	-3.85	0.05	-0.03	0.5	3.63	4.97

TABLE 20.2

APPENDED HULL RESULTS, L/R = 0.206, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 12.5 knots											
2287	20	-6	-2.1	-1.6	-50.43	-5.84	0.05	-5.22	0.1	3.31	4.98
2233	20	0	-2.2	0.1	-50.43	-5.86	0.04	-2.85	0.3	3.32	4.98
2236	20	6	-2.4	1.8	-50.43	-5.99	0.03	-1.78	0.5	3.45	4.99
2258	20	9	-2.6	2.8	-50.43	-6.09	0.04	-1.49	0.6	3.56	4.98
2262	20	12	-2.5	3.7	-50.43	-6.07	0.05	-0.91	0.5	3.58	4.98
SPEED = 35 knots											
2279	-10	-6	-7.8	-11.1	-50.43	0.55	0.20	-9.05	2.6	4.01	13.91
2277	-10	-3	-7.9	-0.3	-50.43	0.67	0.24	-9.39	2.3	3.89	13.90
2218	-10	0	-7.5	1.5	-50.43	0.56	0.21	-9.42	2.3	3.84	13.89
2253	-10	9	-10.0	22.8	-50.43	0.48	0.36	-6.82	2.5	4.25	13.91
2273	-10	12	-10.9	33.0	-50.43	0.39	0.33	-10.19	3.4	4.82	13.89
2282	0	-6	-8.4	-13.7	-50.43	-1.95	0.28	-17.40	2.3	3.98	13.96
2215	0	0	-7.3	0.3	-50.43	-2.08	0.21	-12.21	2.2	3.72	13.88
2247	0	6	-8.5	14.0	-50.43	-2.38	0.21	-14.52	3.0	4.23	13.95
2250	0	9	-8.8	18.0	-50.43	-1.11	0.26	-7.50	2.7	4.13	13.97
2269	0	12	-10.2	27.5	-50.43	-0.22	0.47	2.83	1.6	3.85	13.90
2285	10	-6	-9.2	-16.1	-50.43	-4.00	0.35	-22.75	2.1	3.99	13.94
2230	10	0	-7.7	-0.9	-50.43	-4.79	0.25	-14.89	2.1	3.71	13.85
2240	10	6	-8.0	13.4	-50.43	-4.52	0.20	-15.30	2.8	4.01	13.94
2244	10	6	-8.9	16.1	-50.43	-1.82	0.24	-12.55	3.0	4.35	13.91
2256	10	9	-8.2	15.8	-50.43	-3.00	0.29	-6.64	2.0	3.67	13.94
2266	10	12	-8.1	21.4	-50.43	-2.33	0.25	-7.87	2.3	3.74	13.95
2289	20	-6	-9.3	-14.5	-50.43	-6.00	0.34	-24.27	2.1	3.83	13.94
2234	20	0	-8.1	-0.6	-50.43	-6.84	0.26	-13.90	2.1	3.69	13.91
2237	20	6	-8.1	13.6	-50.43	-6.89	0.23	-14.30	2.4	3.77	13.92
2260	20	9	-8.0	16.8	-50.43	-5.29	0.29	-8.86	1.7	3.40	13.94
2263	20	12	-7.7	22.4	-50.43	-4.46	0.30	-5.18	1.4	3.19	13.92

TABLE 21

RUDDER EFFECTIVENESS RESULTS, L/R = 0, AXES A
 Displacement 135 long tons
 Roll = Yaw = 0 deg

Run No.	Rudder δ deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 knots										
1215	0	-0.3	0.0	-50.43	-0.10	-0.02	0.10	-0.3	2.81	0.00
1263	5	-0.3	0.0	-50.43	-0.08	-0.02	0.10	-0.3	2.87	0.00
1259	10	-0.3	0.0	-50.43	-0.09	-0.02	0.10	-0.3	2.88	0.00
1255	15	-0.3	0.0	-50.43	-0.07	-0.02	0.10	-0.3	2.84	0.00
SPEED = 12.5 knots										
1210	0	-2.2	0.0	-50.43	-0.14	0.08	0.20	0.0	3.22	4.98
1265	5	-2.3	0.4	-50.43	-0.16	0.08	-0.60	0.0	3.21	4.98
1261	10	-2.3	0.6	-50.43	-0.20	0.08	-1.00	0.0	3.23	4.98
1256	15	-2.4	0.7	-50.43	-0.23	0.12	-1.30	-0.3	3.07	4.97
SPEED = 35 knots										
1217	0	-7.9	0.3	-50.43	-0.11	0.29	0.70	1.8	3.37	13.95
1264	5	-8.1	2.0	-50.43	-0.86	0.30	-3.81	1.8	3.37	13.95
1260	10	-8.3	2.8	-50.43	-1.10	0.32	-5.41	1.8	3.36	13.94
1262	10	-8.3	2.8	-50.43	-1.10	0.32	-5.41	1.8	3.37	13.92
1257	15	-9.5	3.8	-50.43	-1.31	0.58	-8.00	0.0	2.77	13.94
1258	15	-9.4	3.8	-50.43	-1.31	0.57	-7.90	0.0	2.77	13.94

TABLE 22

BARE HULL STATIC ROLL RESULTS, L/R = 0.206, AXES A
Speed = 0 knots

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
DISPLACEMENT = 135 long tons											
2554	-21	0	-0.3	-0.1	-50.43	4.99	-0.06	-0.01	0.1	2.89	0.00
2553	-16	0	-0.3	-0.1	-50.43	4.12	-0.06	-0.00	0.1	2.93	0.00
2552	-11	0	-0.3	-0.1	-50.43	3.00	-0.06	-0.00	0.1	2.94	0.00
2551	-5	0	-0.3	-0.1	-50.43	1.21	-0.05	0.00	0.0	2.90	0.00
2550	-3	0	-0.3	-0.1	-50.43	0.51	-0.05	0.00	0.0	2.88	0.00
2555	0	0	-0.2	-0.1	-50.43	-0.52	-0.06	0.00	0.0	2.87	0.00
2543	0	0	-0.3	-0.1	-50.43	-0.50	-0.05	0.00	0.0	2.87	0.00
2544	5	0	-0.3	-0.1	-50.43	-1.96	-0.05	0.10	0.0	2.87	0.00
2546	10	0	-0.3	-0.1	-50.43	-3.75	-0.05	0.11	0.0	2.86	0.00
2545	10	0	-0.3	-0.1	-50.43	-3.92	-0.05	0.11	0.0	2.86	0.00
2547	16	0	-0.3	-0.1	-50.43	-5.09	-0.05	0.11	0.0	2.81	0.00
2548	20	0	-0.2	-0.1	-50.43	-5.68	-0.05	0.11	-0.1	2.75	0.00
2549	21	0	-0.3	-0.1	-50.43	-5.84	-0.04	0.01	-0.1	2.74	0.00

DISPLACEMENT = 155 long tons

2541	-20	0	-0.3	-0.1	-57.90	5.27	-0.08	-0.01	0.3	3.27	0.00
2540	-16	0	-0.3	-0.1	-57.90	4.43	-0.08	-0.00	0.2	3.27	0.00
2539	-10	0	-0.3	-0.1	-57.90	2.82	-0.08	-0.00	0.2	3.24	0.00
2538	-5	0	-0.3	-0.1	-57.90	1.16	-0.07	0.00	0.1	3.20	0.00
2542	-3	0	-0.3	-0.1	-57.90	0.43	-0.07	0.10	0.1	3.19	0.00
2532	0	0	-0.3	-0.1	-57.90	-0.59	-0.06	0.00	0.0	3.18	0.00
2533	5	0	-0.3	-0.1	-57.90	-2.34	-0.06	0.10	0.0	3.17	0.00
2534	10	0	-0.3	-0.1	-57.90	-4.02	-0.07	0.11	0.1	3.18	0.00
2535	16	0	-0.3	-0.1	-57.90	-5.48	-0.07	0.01	0.1	3.16	0.00
2536	20	0	-0.3	-0.1	-57.90	-6.28	-0.07	0.11	0.1	3.12	0.00
2537	21	0	-0.3	-0.1	-57.90	-6.47	-0.06	0.11	0.0	3.11	0.00

TABLE 23.1

BARE HULL RESULTS, L/R = 0, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 knots											
1325	-20	-6	0.12	17.15	-47.42	5.20	-0.06	0.11	-0.4	2.81	0.00
1322	-10	-6	0.10	8.76	-49.66	3.13	-0.05	0.12	-0.3	2.81	0.00
1328	0	-6	0.10	-0.10	-50.43	-0.13	-0.02	0.10	-0.3	2.83	0.00
1272	0	0	0.10	0.00	-50.43	-0.11	-0.02	0.10	-0.3	2.79	0.00
1318	0	3	0.20	0.00	-50.43	-0.09	-0.03	0.10	-0.3	2.82	0.00
1275	0	6	0.20	0.00	-50.43	-0.11	-0.03	0.10	-0.3	2.83	0.00
1278	0	9	0.20	0.00	-50.43	-0.11	-0.03	0.10	-0.3	2.79	0.00
1316	0	11	0.20	0.00	-50.43	-0.06	-0.03	0.10	-0.3	2.86	0.00
1281	0	12	0.20	0.00	-50.43	-0.08	-0.03	0.10	-0.3	2.79	0.00
1314	0	12	0.20	0.10	-50.43	-0.03	-0.03	0.10	-0.3	2.80	0.00
1285	10	0	0.19	-8.76	-49.66	-3.38	-0.02	0.08	-0.2	2.84	0.00
1320	10	3	0.29	-8.76	-49.66	-3.36	-0.03	0.08	-0.2	2.84	0.00
1289	10	6	0.19	-8.76	-49.66	-3.34	-0.02	0.08	-0.2	2.84	0.00
1292	10	9	0.29	-8.76	-49.66	-3.33	-0.03	0.08	-0.2	2.86	0.00
1295	10	12	0.29	-8.66	-49.68	-3.31	-0.03	0.08	-0.2	2.85	0.00
1298	20	0	0.19	-17.25	-47.39	-5.39	-0.01	0.06	-0.2	2.83	0.00
1312	20	3	0.19	-17.25	-47.39	-5.38	-0.01	0.06	-0.2	2.82	0.00
1301	20	6	0.29	-17.25	-47.39	-5.37	-0.02	0.06	-0.2	2.83	0.00
1306	20	9	0.29	-17.25	-47.39	-5.35	-0.02	0.06	-0.2	2.81	0.00
1309	20	12	0.29	-17.25	-47.39	-5.33	-0.02	0.06	-0.2	2.83	0.00
SPEED = 12.5 knots											
1326	-20	-6	-1.63	16.32	-47.76	5.03	0.48	-1.09	0.0	3.21	4.98
1323	-10	-6	-1.63	7.97	-49.83	2.96	0.37	-1.65	0.0	3.27	4.97
1329	0	-6	-1.54	-0.90	-50.46	-0.05	0.07	-1.90	0.1	3.29	4.98
1273	0	0	-1.43	0.00	-50.45	-0.10	0.07	0.10	0.0	3.20	4.97
1276	0	6	-1.54	1.00	-50.46	-0.19	0.07	2.50	0.1	3.28	4.98
1279	0	9	-1.63	1.70	-50.46	-0.19	0.08	4.20	0.0	3.27	4.98
1282	0	12	-1.73	2.90	-50.46	-0.10	0.09	6.40	0.0	3.31	4.97
1283	0	12	-1.73	2.80	-50.46	-0.13	0.09	6.30	0.0	3.33	4.98
1286	10	0	-1.44	-8.86	-49.67	-3.20	0.08	0.07	0.1	3.25	4.98
1290	10	6	-1.54	-7.78	-49.87	-3.17	0.45	2.13	0.1	3.29	4.97
1293	10	9	-1.54	-7.09	-49.99	-3.16	0.73	3.71	0.1	3.31	4.98
1296	10	12	-1.73	-6.20	-50.14	-3.10	1.09	5.68	0.0	3.33	4.98
1299	20	0	-1.25	-17.35	-47.38	-5.23	-0.04	-0.24	0.2	3.18	4.98
1302	20	6	-1.45	-16.23	-47.79	-5.23	0.59	1.45	0.2	3.26	4.98
1307	20	9	-1.55	-15.47	-48.07	-5.22	1.01	2.58	0.2	3.29	4.97
1310	20	12	-1.64	-14.63	-48.37	-5.24	1.53	3.99	0.1	3.30	4.97

TABLE 23.2

BARE HULL RESULTS, L/R = 0, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 35 knots											
1327	-20	-6	-5.56	8.34	-50.98	2.73	0.25	0.06	2.0	3.43	13.94
1324	-10	-6	-5.35	0.14	-51.49	0.52	0.68	-2.36	1.9	3.44	13.93
1274	0	0	-5.33	0.30	-50.71	-0.16	0.27	0.49	1.7	3.33	13.93
1319	0	3	-5.25	5.30	-50.73	0.75	0.26	3.72	1.9	3.45	13.93
1277	0	6	-5.40	11.10	-50.79	1.82	0.25	4.86	2.3	3.66	13.95
1280	0	9	-5.45	17.80	-50.87	3.35	0.24	3.44	2.8	3.97	13.93
1317	0	11	-5.50	22.30	-50.93	4.42	0.23	2.00	3.2	4.19	13.92
1284	0	12	-5.53	25.30	-50.98	5.12	0.22	0.75	3.5	4.32	13.94
1315	0	12	-5.43	25.10	-50.97	5.10	0.21	0.85	3.5	4.27	13.92
1287	10	0	-5.45	-9.30	-49.88	-2.82	-0.16	-2.45	1.9	3.40	13.93
1288	10	0	-5.44	-9.30	-49.87	-2.82	-0.15	-2.45	1.8	3.37	13.92
1321	10	3	-5.25	-3.88	-50.83	-1.85	0.51	1.42	1.9	3.36	13.95
1291	10	6	-5.17	1.33	-51.77	-0.56	0.66	2.35	2.1	3.48	13.93
1294	10	9	-4.65	6.64	-52.77	1.29	0.20	0.07	2.8	3.73	13.92
1297	10	12	-4.78	11.16	-53.61	2.73	0.18	-0.05	3.0	3.73	13.95
1300	20	0	-5.67	-18.40	-47.34	-4.95	-0.76	-2.87	2.1	3.46	13.93
1313	20	3	-5.66	-12.76	-49.38	-4.12	-0.06	-0.96	2.0	3.41	13.90
1305	20	6	-5.21	-6.19	-51.80	-2.67	-0.41	-1.77	2.4	3.54	13.93
1308	20	9	-4.35	-0.46	-53.89	-0.96	-0.73	-2.46	2.8	3.60	13.94
1311	20	12	-4.14	2.37	-54.89	0.27	-0.45	-1.65	2.7	3.35	13.93

TABLE 24.1

BARE HULL RESULTS, L/R = 0.206, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 knots											
2198	-10	-6	0.47	8.56	-49.70	2.69	-0.07	0.03	0.0	2.99	0.00
2137	-10	0	0.47	8.66	-49.68	2.75	-0.07	0.02	0.0	2.84	0.00
2153	-10	6	0.56	8.66	-49.68	2.91	-0.09	0.13	0.1	2.98	0.00
2175	-10	9	0.56	8.66	-49.68	2.72	-0.08	0.03	0.1	2.99	0.00
2195	-10	12	0.56	8.66	-49.68	2.77	-0.09	0.13	0.1	3.00	0.00
2202	0	-6	0.38	-0.20	-50.43	-0.52	-0.05	-0.00	-0.1	2.92	0.00
2133	0	0	0.38	0.00	-50.43	-0.37	-0.05	-0.10	-0.1	2.82	0.00
2135	0	0	0.38	-0.10	-50.43	-0.43	-0.05	-0.00	-0.1	2.81	0.00
2147	0	6	0.38	-0.10	-50.43	-0.45	-0.05	0.10	-0.1	2.88	0.00
2146	0	6	0.38	-0.10	-50.43	-0.46	-0.05	0.10	-0.1	2.88	0.00
2192	0	12	0.47	-0.10	-50.43	-0.49	-0.06	0.10	0.0	2.94	0.00
2205	10	-6	0.38	-8.86	-49.65	-3.74	-0.06	-0.03	-0.1	2.90	0.00
2140	10	0	0.38	-8.86	-49.65	-3.71	-0.06	-0.03	-0.1	2.75	0.00
2156	10	6	0.38	-8.86	-49.65	-3.49	-0.04	0.07	-0.1	2.93	0.00
2178	10	9	0.47	-8.86	-49.64	-3.70	-0.05	0.06	0.0	2.92	0.00
2188	10	12	0.47	-8.86	-49.64	-3.75	-0.05	0.06	0.0	2.93	0.00
2208	20	-6	0.38	-17.44	-47.32	-5.85	-0.07	-0.04	-0.1	2.78	0.00
2210	20	-6	0.38	-17.34	-47.35	-5.84	-0.07	-0.04	-0.1	2.78	0.00
2143	20	0	0.38	-17.34	-47.35	-5.67	-0.07	-0.04	-0.1	2.64	0.00
2160	20	6	0.38	-17.34	-47.35	-5.76	-0.03	0.05	-0.1	2.83	0.00
2181	20	9	0.48	-17.34	-47.35	-5.70	-0.04	0.06	-0.1	2.83	0.00
2184	20	12	0.47	-17.34	-47.35	-5.73	-0.04	0.05	0.0	2.83	0.00
SPEED = 12.5 knots											
2201	-10	-6	-1.15	7.39	-49.94	2.68	0.83	-4.47	0.3	3.42	4.98
2138	-10	0	-1.15	8.67	-49.71	2.60	0.34	-1.74	0.4	3.34	4.98
2154	-10	6	-1.25	9.74	-49.53	2.56	0.01	0.12	0.6	3.58	4.97
2176	-10	9	-1.31	10.43	-49.42	2.19	-0.12	0.88	0.7	3.69	4.99
2196	-10	12	-1.46	11.50	-49.24	2.15	-0.29	1.85	0.8	3.82	4.98
2203	0	-6	-1.14	-1.71	-50.46	-0.34	0.04	-4.97	0.2	3.39	4.96
2134	0	0	-1.23	-0.09	-50.46	-0.25	0.04	-2.00	0.3	3.34	5.00
2150	0	6	-1.24	0.78	-50.47	-0.40	0.04	0.18	0.5	3.50	4.95
2151	0	6	-1.24	0.79	-50.47	-0.42	0.04	0.18	0.5	3.50	4.96
2173	0	9	-1.29	1.47	-50.47	-0.49	0.04	0.96	0.5	3.59	4.93
2193	0	12	-1.44	2.27	-50.48	-0.56	0.05	2.14	0.6	3.69	4.97
2206	10	-6	-1.24	-10.53	-49.38	-3.48	-0.82	-4.93	0.2	3.37	4.98
2141	10	0	-1.23	-8.95	-49.66	-3.45	-0.31	-2.01	0.3	3.24	4.99
2157	10	6	-1.24	-7.98	-49.84	-3.24	0.04	0.03	0.5	3.48	4.98
2179	10	9	-1.38	-7.20	-49.98	-3.38	0.17	0.71	0.5	3.55	4.98
2189	10	12	-1.53	-6.52	-50.10	-3.42	0.37	1.78	0.5	3.61	4.98

TABLE 24.2

BARE HULL RESULTS, L/R = 0.206, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 12.5 knots											
2209	20	-6	-1.23	-18.85	-46.83	-5.76	-1.67	-4.72	0.1	3.25	4.98
2144	20	0	-1.23	-17.35	-47.39	-5.57	-0.73	-2.13	0.3	3.12	4.98
2161	20	6	-1.34	-16.14	-47.84	-5.61	-0.20	-0.66	0.5	3.41	4.98
2182	20	9	-1.29	-15.30	-48.14	-5.62	-0.04	-0.21	0.5	3.47	4.97
2186	20	12	-1.53	-14.37	-48.48	-5.61	0.25	0.53	0.5	3.52	4.99
SPEED = 35 knots											
2199	-10	-6	-4.47	-1.28	-51.78	0.53	2.27	-11.84	2.5	3.92	13.94
2139	-10	0	-4.64	9.08	-49.95	1.80	1.20	-5.68	2.4	3.71	14.02
2155	-10	6	-5.12	21.11	-47.94	2.10	0.92	-4.05	3.0	4.29	13.84
2177	-10	9	-4.96	29.11	-46.64	2.29	1.59	-8.08	3.8	4.77	13.90
2197	-10	12	-4.91	36.73	-45.44	2.69	2.35	-12.59	4.7	5.31	13.91
2204	0	-6	-5.12	-13.25	-50.76	-1.45	0.24	-20.62	2.2	3.88	13.86
2556	0	-6	-4.44	-13.02	-50.74	-1.46	0.19	-20.53	2.3	3.86	13.95
2136	0	0	-4.71	-1.25	-50.73	-0.72	0.22	-9.12	2.1	3.61	13.93
2557	0	0	-4.72	-0.82	-50.74	-0.76	0.21	-8.93	2.2	3.70	13.95
2152	0	6	-4.50	10.17	-50.81	0.32	0.17	-5.52	2.8	4.09	13.84
2558	0	6	-4.50	10.60	-50.82	0.27	0.17	-5.53	2.9	4.07	13.95
2174	0	9	-4.32	16.73	-50.88	0.91	0.14	-7.34	3.4	4.35	13.87
2194	0	12	-4.33	23.57	-50.95	1.69	0.12	-10.45	3.9	4.66	13.90
2559	0	12	-4.42	23.73	-50.97	1.68	0.12	-10.36	4.0	4.65	13.95
2212	10	-6	-6.32	-24.63	-47.25	-3.25	-4.19	-25.61	2.1	3.96	13.94
2142	10	0	-5.58	-11.11	-49.55	-3.31	-1.74	-11.49	1.8	3.38	13.94
2158	10	6	-4.74	-0.03	-51.53	-2.05	-0.69	-5.08	2.3	3.73	13.88
2180	10	9	-4.25	6.26	-52.69	-1.00	-0.92	-6.06	2.9	3.96	13.94
2190	10	12	-4.24	10.65	-53.49	-0.07	-1.16	-7.39	3.1	4.03	13.90
2191	10	12	-4.24	10.77	-53.51	-0.06	-1.16	-7.39	3.1	4.03	13.92
2211	20	-6	-5.79	-29.94	-43.24	-5.90	-6.09	-17.46	2.7	4.04	13.95
2145	20	0	-5.50	-18.97	-47.11	-5.53	-4.05	-11.89	2.0	3.38	13.96
2162	20	6	-5.11	-8.19	-51.02	-4.71	-2.27	-6.91	2.1	3.55	13.91
2183	20	9	-4.80	-1.81	-53.36	-3.62	-2.06	-6.25	2.3	3.59	13.88
2187	20	12	-4.14	1.47	-54.51	-2.55	-1.87	-5.61	2.3	3.45	13.94

TABLE 25.1

BARE HULL RESULTS, L/R = 0.412, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 knots											
3322	-10	-6	0.47	8.76	-49.66	2.78	-0.08	0.12	0.0	2.92	0.00
3373	-10	-6	0.47	8.76	-49.66	2.77	-0.07	0.02	0.0	2.86	0.00
3319	-10	0	0.47	8.76	-49.66	2.76	-0.07	0.02	0.0	2.92	0.00
3337	-10	6	0.47	8.66	-49.68	2.76	-0.07	0.02	0.0	2.86	0.00
3356	-10	9	0.47	8.76	-49.66	2.69	-0.07	0.02	0.0	2.88	0.00
3359	-10	12	0.47	8.76	-49.66	2.75	-0.08	0.12	0.0	2.88	0.00
3380	0	-6	0.38	-0.10	-50.43	-0.49	-0.05	-0.00	-0.1	2.81	0.00
3310	0	0	0.48	-0.10	-50.43	-0.48	-0.06	-0.00	-0.1	2.88	0.00
3334	0	6	0.38	-0.00	-50.43	-0.47	-0.05	-0.01	-0.1	2.80	0.00
3352	0	9	0.38	-0.00	-50.43	-0.51	-0.05	-0.01	-0.1	2.81	0.00
3363	0	12	0.38	0.00	-50.43	-0.49	-0.05	0.09	-0.1	2.83	0.00
3387	10	-6	0.39	-8.76	-49.66	-3.74	-0.05	-0.03	-0.2	2.77	0.00
3313	10	0	0.38	-8.76	-49.66	-3.70	-0.06	-0.03	-0.1	2.86	0.00
3340	10	6	0.38	-8.76	-49.66	-3.78	-0.06	-0.03	-0.1	2.82	0.00
3349	10	9	0.38	-8.76	-49.66	-3.72	-0.06	-0.03	-0.1	2.82	0.00
3365	10	12	0.38	-8.76	-49.66	-3.79	-0.04	0.07	-0.1	2.82	0.00
3392	20	-6	0.39	-17.25	-47.39	-5.80	-0.06	-0.04	-0.2	2.65	0.00
3316	20	0	0.48	-17.25	-47.39	-5.69	-0.04	0.05	-0.1	2.76	0.00
3343	20	6	0.38	-17.34	-47.35	-5.69	-0.07	-0.04	-0.1	2.72	0.00
3346	20	9	0.38	-17.34	-47.35	-5.74	-0.03	0.05	-0.1	2.73	0.00
3368	20	12	0.38	-17.25	-47.39	-5.77	-0.03	0.05	-0.1	2.73	0.00
SPEED = 12.5 knots											
3323	-10	-6	-1.43	6.60	-50.07	2.86	1.59	-8.60	0.0	3.29	4.98
3320	-10	0	-1.25	8.68	-49.71	2.64	0.73	-3.91	0.4	3.42	4.98
3338	-10	6	-1.45	10.04	-49.49	2.26	0.32	-1.57	0.7	3.56	4.98
3357	-10	9	-1.46	10.91	-49.35	2.01	0.25	-1.20	0.9	3.72	4.98
3360	-10	12	-1.56	11.99	-49.17	1.86	0.20	-0.92	1.1	3.90	5.00
3381	0	-6	-1.33	-2.81	-50.45	-0.24	0.06	-9.45	0.0	3.20	4.97
3382	0	-6	-1.33	-2.83	-50.45	-0.21	0.06	-9.35	0.0	3.21	4.94
3311	0	0	-1.23	-0.40	-50.46	-0.31	0.04	-4.40	0.3	3.38	4.97
3335	0	6	-1.42	1.00	-50.47	-0.44	0.05	-1.63	0.5	3.46	4.99
3354	0	9	-1.43	1.69	-50.48	-0.53	0.04	-0.95	0.7	3.57	4.99
3362	0	12	-1.54	2.47	-50.50	-0.62	0.04	-0.37	0.9	3.73	4.99
3388	10	-6	-1.43	-11.70	-49.17	-3.45	-1.56	-9.23	0.0	3.16	5.00
3314	10	0	-1.43	-9.06	-49.65	-3.37	-0.73	-4.47	0.3	3.37	4.97
3341	10	6	-1.44	-7.59	-49.92	-3.39	-0.30	-1.95	0.6	3.44	4.98
3350	10	9	-1.53	-6.81	-50.06	-3.27	-0.16	-1.18	0.7	3.54	4.99
3366	10	12	-1.62	-6.15	-50.18	-3.28	-0.03	-0.50	0.7	3.59	4.98

TABLE 25.2

BARE HULL RESULTS, L/R = 0.412, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 12.5 knots											
3393	20	-6	-1.33	-19.32	-46.66	-5.77	-2.75	-7.71	0.0	3.04	4.98
3317	20	0	-1.33	-17.44	-47.36	-5.63	-1.58	-4.48	0.3	3.29	4.98
3344	20	6	-1.52	-15.66	-48.01	-5.61	-0.87	-2.55	0.5	3.33	4.99
3347	20	9	-1.64	-14.76	-48.36	-5.63	-0.71	-2.11	0.7	3.48	4.97
3369	20	12	-1.64	-13.75	-48.73	-5.65	-0.62	-1.86	0.8	3.55	4.97
SPEED = 35 knots											
3375	-10	-6	-5.05	-4.37	-52.31	0.97	5.51	-29.89	2.2	3.79	14.00
3321	-10	0	-4.47	9.71	-49.85	1.32	2.84	-15.09	2.6	3.98	13.97
3339	-10	6	-4.67	25.20	-47.29	1.46	2.98	-16.05	3.7	4.52	13.98
3358	-10	9	-4.74	33.73	-45.92	1.74	3.72	-20.42	4.5	5.01	14.01
3361	-10	12	-4.56	42.82	-44.49	2.18	4.87	-27.20	5.6	5.60	14.00
3312	0	0	-4.83	-2.27	-50.75	-0.78	0.22	-20.62	2.2	3.75	13.86
3336	0	6	-4.50	12.81	-50.85	-0.07	0.16	-15.23	3.1	4.13	13.98
3355	0	9	-4.60	19.83	-50.93	0.52	0.15	-17.87	3.6	4.38	13.88
3364	0	12	-4.39	27.28	-51.02	1.31	0.11	-21.42	4.3	4.72	13.89
3315	10	0	-6.03	-13.67	-49.06	-2.88	-4.32	-26.38	1.4	3.37	13.99
3342	10	6	-5.00	0.84	-51.69	-2.28	-2.29	-14.28	2.2	3.56	13.98
3351	10	9	-4.74	7.23	-52.85	-1.18	-2.18	-13.48	2.6	3.70	13.99
3367	10	12	-4.46	12.22	-53.74	-0.04	-2.25	-13.73	2.8	3.75	14.01
3395	20	-6	-5.69	-27.08	-44.26	-6.20	-8.28	-23.46	2.6	3.74	13.99
3318	20	0	-5.76	-19.72	-46.80	-5.56	-8.43	-23.99	1.7	3.41	14.00
3345	20	6	-5.55	-8.43	-50.89	-4.69	-5.26	-15.24	1.6	3.14	13.93
3348	20	9	-5.41	-2.75	-52.94	-3.72	-4.30	-12.59	1.5	3.08	14.00
3371	20	12	-5.34	2.15	-54.69	-2.60	-3.29	-9.82	1.3	2.93	13.91

TABLE 26

SUPPLEMENTAL BARE HULL RESULTS, L/R = 0.412, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 to 28 knots											
3428	0	-5	0.48	-0.10	-50.43	-0.49	-0.06	-0.00	-0.1	2.82	0.00
3429	0	-5	-1.43	-2.23	-50.45	-0.28	0.07	-8.16	0.0	3.23	4.94
3434	0	-5	-2.08	-3.42	-50.49	-0.14	0.09	-13.14	0.5	3.63	5.98
3430	0	-5	-2.37	-4.52	-50.55	0.02	0.08	-17.22	1.3	4.10	6.94
3431	0	-5	-3.11	-7.42	-50.63	-0.24	0.11	-23.78	1.9	4.16	9.05
3433	0	-5	-4.66	-12.79	-50.63	-0.35	0.24	-34.17	1.3	3.67	11.08
3406	-10	-6	0.57	8.66	-49.68	2.73	-0.07	0.02	0.0	2.82	0.00
3403	0	-6	0.48	-0.10	-50.43	-0.51	-0.06	-0.00	-0.1	2.74	0.00
3436	0	-6	0.39	-0.10	-50.43	-0.55	-0.05	-0.00	-0.2	2.81	0.00
3408	10	-6	0.48	-8.76	-49.66	-3.74	-0.06	-0.03	-0.1	2.72	0.00
3391	20	-6	0.39	-17.25	-47.39	-5.78	-0.06	-0.04	-0.2	2.64	0.00
3410	20	-6	0.30	-16.97	-47.49	-5.75	-0.02	0.06	-0.3	2.58	0.00
3441	0	-6	-0.08	-0.64	-50.43	-0.46	-0.02	-2.39	-0.2	2.92	2.92
3435	0	-6	-1.33	-2.71	-50.45	-0.33	0.06	-9.35	0.0	3.19	4.97
3440	0	-6	-2.06	-4.21	-50.48	-0.20	0.10	-15.33	0.4	3.62	5.99
3407	-10	-6	-2.39	4.33	-50.57	2.96	3.08	-16.98	1.4	4.09	7.02
3405	0	-6	-2.39	-5.61	-50.56	0.13	0.08	-20.09	1.4	4.05	7.03
3412	0	-6	-2.48	-5.63	-50.55	0.10	0.09	-20.09	1.3	4.08	7.01
3437	0	-6	-2.48	-5.67	-50.55	-0.01	0.09	-20.20	1.3	4.13	7.06
3409	10	-6	-2.58	-14.71	-48.74	-3.11	-3.58	-20.85	1.3	4.02	7.02
3411	20	-6	-2.79	-20.79	-46.25	-5.75	-5.66	-15.86	1.4	3.93	7.02
3384	0	-6	-2.85	-7.94	-50.62	0.02	0.09	-25.36	1.9	4.24	8.66
3438	0	-6	-3.21	-9.11	-50.63	-0.26	0.12	-27.05	1.9	4.19	9.06
3385	0	-6	-3.94	-12.92	-50.62	-0.13	0.18	-34.36	1.5	3.87	10.22
3390	10	-6	-4.38	-22.34	-47.50	-3.12	-5.87	-34.50	1.6	3.82	10.42
3394	20	-6	-4.42	-25.68	-44.60	-5.73	-8.80	-24.73	1.9	3.83	10.41

TABLE 27.1

BARE HULL RESULTS, L/R = 0.206, AXES B
Displacement 155 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 knots											
2529	-10	-6	0.57	9.96	-57.04	3.04	-0.08	0.03	0.1	3.25	0.00
2461	-10	0	0.57	9.96	-57.04	2.82	-0.08	0.03	0.1	3.28	0.00
2479	-10	6	0.57	9.96	-57.04	2.82	-0.08	0.03	0.1	3.26	0.00
2482	-10	9	0.57	9.96	-57.04	2.84	-0.08	0.03	0.1	3.27	0.00
2506	-10	12	0.67	10.05	-57.02	3.01	-0.11	0.13	0.2	3.29	0.00
2442	0	-6	0.67	0.00	-57.90	0.00	-0.07	0.00	-0.1	3.10	0.00
2526	0	-6	0.47	-0.10	-57.90	-0.59	-0.06	-0.01	0.0	3.18	0.00
2458	0	0	0.47	0.00	-57.90	-0.51	-0.06	-0.01	0.0	3.22	0.00
2476	0	6	0.47	-0.10	-57.90	-0.61	-0.06	-0.01	0.0	3.21	0.00
2485	0	9	0.47	-0.10	-57.90	-0.57	-0.06	0.09	0.0	3.22	0.00
2503	0	12	0.57	0.00	-57.90	-0.58	-0.07	0.09	0.1	3.20	0.00
2523	10	-6	0.47	-10.15	-57.00	-4.12	-0.07	-0.04	0.0	3.18	0.00
2464	10	0	0.47	-10.15	-57.00	-3.99	-0.05	0.06	0.0	3.20	0.00
2473	10	6	0.47	-10.15	-57.00	-3.92	-0.05	0.06	0.0	3.21	0.00
2488	10	9	0.47	-10.25	-56.98	-4.04	-0.03	0.16	0.0	3.23	0.00
2489	10	9	0.47	-10.15	-57.00	-3.94	-0.05	0.06	0.0	3.20	0.00
2510	10	12	0.47	-10.15	-57.00	-4.15	-0.06	0.05	0.1	3.22	0.00
2520	20	-6	0.47	-19.90	-54.37	-6.27	-0.05	0.04	0.0	3.14	0.00
2467	20	0	0.47	-19.90	-54.37	-6.40	-0.08	-0.05	0.0	3.13	0.00
2518	20	0	0.47	-19.90	-54.37	-6.28	-0.05	0.04	0.0	3.14	0.00
2470	20	6	0.47	-19.90	-54.37	-6.38	-0.05	0.04	0.0	3.14	0.00
2516	20	6	0.57	-19.80	-54.41	-6.32	-0.09	-0.06	0.1	3.16	0.00
2492	20	9	0.47	-19.90	-54.37	-6.41	-0.05	0.04	0.0	3.13	0.00
2513	20	12	0.47	-19.90	-54.37	-6.31	-0.05	0.04	0.1	3.17	0.00
SPEED = 12.5 knots											
2530	-10	-6	-1.21	8.58	-57.32	3.02	0.95	-5.15	0.4	3.70	4.97
2462	-10	0	-1.29	10.17	-57.04	2.70	0.38	-1.94	0.5	3.80	5.00
2480	-10	6	-1.37	11.34	-56.85	2.45	0.04	0.01	0.7	3.91	4.99
2483	-10	9	-1.62	12.11	-56.72	2.34	-0.12	0.98	0.7	4.01	4.96
2507	-10	12	-1.76	13.49	-56.50	2.42	-0.32	2.14	1.0	4.20	4.99
2527	0	-6	-1.21	-1.80	-57.93	-0.41	0.04	-5.77	0.3	3.66	4.97
2459	0	0	-1.39	0.02	-57.94	-0.44	0.05	-2.11	0.4	3.74	5.01
2477	0	6	-1.38	1.08	-57.95	-0.59	0.04	0.06	0.6	3.86	4.94
2486	0	9	-1.62	1.78	-57.95	-0.60	0.06	1.05	0.6	3.91	4.96
2504	0	12	-1.77	2.75	-57.96	-0.64	0.06	2.33	0.7	4.03	4.93
2524	10	-6	-1.31	-12.03	-56.71	-3.89	-0.94	-5.63	0.3	3.65	4.98
2465	10	0	-1.39	-10.26	-57.03	-3.73	-0.32	-2.12	0.4	3.72	4.97
2474	10	6	-1.48	-8.89	-57.27	-3.64	0.04	-0.08	0.5	3.82	4.97
2490	10	9	-1.62	-8.21	-57.40	-3.63	0.20	0.80	0.5	3.84	4.96
2511	10	12	-1.66	-7.23	-57.58	-3.76	0.40	1.95	0.7	3.93	4.98

TABLE 27.2

BARE HULL RESULTS, L/R = 0.206, AXES B
Displacement 155 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 12.5 knots											
2521	20	-6	-1.31	-21.60	-53.79	-6.14	-1.91	-5.39	0.3	3.62	4.97
2468	20	0	-1.29	-19.91	-54.41	-6.26	-0.81	-2.33	0.4	3.64	4.96
2471	20	6	-1.38	-18.41	-54.97	-6.23	-0.21	-0.68	0.6	3.75	4.98
2493	20	9	-1.62	-17.48	-55.31	-6.27	0.01	-0.14	0.6	3.82	5.00
2514	20	12	-1.66	-16.46	-55.69	-6.11	0.31	0.68	0.7	3.90	4.98
SPEED = 35 knots											
2531	-10	-6	-4.63	-1.64	-59.52	0.56	2.25	-11.81	3.0	4.34	13.94
2463	-10	0	-4.93	10.47	-57.36	1.75	1.38	-6.68	2.7	4.26	13.93
2481	-10	6	-5.11	24.59	-55.01	2.18	1.19	-5.69	3.5	4.77	13.92
2484	-10	9	-5.15	32.80	-53.70	2.53	1.73	-8.92	4.3	5.28	13.91
2508	-10	12	-4.96	41.36	-52.39	3.13	2.40	-13.06	5.4	5.87	13.95
2528	0	-6	-5.73	-15.22	-58.32	-1.54	0.27	-21.99	2.5	4.24	13.89
2460	0	0	-4.93	-0.87	-58.27	-0.83	0.21	-10.14	2.5	4.12	13.91
2478	0	6	-4.62	12.63	-58.37	0.31	0.16	-7.18	3.3	4.56	13.89
2487	0	9	-4.57	19.52	-58.45	0.99	0.14	-9.41	3.8	4.83	13.86
2505	0	12	-4.50	26.68	-58.56	1.85	0.10	-12.13	4.5	5.16	13.91
2525	10	-6	-6.74	-27.93	-54.34	-3.64	-4.66	-28.35	2.4	4.30	13.93
2466	10	0	-5.94	-12.18	-57.00	-3.40	-1.83	-12.09	2.0	3.91	13.89
2475	10	6	-4.92	1.29	-59.43	-2.25	-1.07	-7.23	2.7	4.16	13.94
2491	10	9	-4.87	7.91	-60.64	-1.28	-0.98	-6.64	3.0	4.32	13.94
2512	10	12	-4.20	12.68	-61.52	-0.17	-1.56	-9.55	3.6	4.42	13.98
2522	20	-6	-6.63	-35.33	-49.33	-6.14	-7.91	-22.59	2.9	4.43	13.96
2469	20	0	-5.93	-21.31	-54.28	-6.14	-4.70	-13.72	2.3	3.98	13.92
2519	20	0	-5.93	-21.50	-54.22	-5.95	-4.73	-13.80	2.3	3.99	13.92
2472	20	6	-5.43	-8.08	-59.09	-4.95	-2.88	-8.59	2.4	3.93	13.96
2517	20	6	-5.53	-8.52	-58.93	-4.81	-2.79	-8.38	2.4	3.94	13.91
2494	20	9	-5.07	-1.20	-61.60	-3.91	-2.54	-7.57	2.6	3.97	13.96
2515	20	12	-4.45	2.30	-62.87	-2.61	-2.49	-7.30	2.8	3.93	13.89

TABLE 28.1

APPENDED HULL RESULTS, L/R = 0, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 knots											
1111	0	0	0.10	0.00	-50.43	-0.02	-0.02	0.10	-0.3	2.82	0.00
1209	0	0	0.10	0.00	-50.43	-0.11	-0.02	0.10	-0.3	2.83	0.00
1215	0	0	0.10	0.00	-50.43	-0.10	-0.02	0.10	-0.3	2.81	0.00
1114	0	6	0.10	0.00	-50.43	-0.01	-0.02	0.10	-0.3	2.82	0.00
1219	0	6	0.10	0.10	-50.43	-0.03	-0.02	0.10	-0.3	2.85	0.00
1117	0	9	0.10	0.00	-50.43	-0.01	-0.02	0.10	-0.3	2.80	0.00
1222	0	9	0.20	0.10	-50.43	-0.06	-0.03	0.10	-0.3	2.84	0.00
1120	0	12	0.10	0.00	-50.43	-0.01	-0.02	0.10	-0.3	2.86	0.00
1225	0	12	0.10	0.10	-50.43	-0.04	-0.02	0.10	-0.3	2.83	0.00
1123	10	0	0.19	-8.76	-49.66	-3.25	-0.02	0.08	-0.2	2.90	0.00
1228	10	0	0.19	-8.76	-49.66	-3.35	-0.02	0.08	-0.2	2.84	0.00
1126	10	6	0.19	-8.76	-49.66	-3.27	-0.02	0.08	-0.2	2.88	0.00
1231	10	6	0.29	-8.76	-49.66	-3.32	-0.03	0.08	-0.2	2.88	0.00
1129	10	9	0.19	-8.76	-49.66	-3.26	-0.02	0.08	-0.2	2.92	0.00
1234	10	9	0.29	-8.76	-49.66	-3.33	-0.03	0.08	-0.2	2.89	0.00
1132	10	12	0.19	-8.76	-49.66	-3.27	-0.02	0.08	-0.2	2.89	0.00
1237	10	12	0.19	-8.66	-49.68	-3.30	-0.02	0.08	-0.2	2.86	0.00
1137	20	0	0.19	-17.34	-47.36	-5.37	-0.01	0.06	-0.2	2.86	0.00
1240	20	0	0.19	-17.25	-47.39	-5.33	-0.01	0.06	-0.2	2.85	0.00
1252	20	3	0.29	-17.25	-47.39	-5.34	0.02	0.16	-0.2	2.81	0.00
1140	20	6	0.19	-17.25	-47.39	-5.24	-0.01	0.06	-0.2	2.86	0.00
1243	20	6	0.29	-17.25	-47.39	-5.33	-0.02	0.06	-0.2	2.85	0.00
1143	20	9	0.19	-17.25	-47.39	-5.23	-0.01	0.06	-0.2	2.87	0.00
1246	20	9	0.29	-17.15	-47.42	-5.31	-0.02	0.06	-0.2	2.85	0.00
1146	20	12	0.19	-17.25	-47.39	-5.25	-0.01	0.06	-0.2	2.83	0.00
1211	20	12	0.28	-17.25	-47.39	-5.36	-0.02	0.06	-0.1	2.83	0.00
1249	20	12	0.19	-17.25	-47.39	-5.33	-0.01	0.06	-0.2	2.84	0.00
SPEED = 12.5 knots											
1112	0	0	-1.53	0.00	-50.45	-0.00	0.08	0.20	0.0	3.23	4.98
1210	0	0	-1.53	0.00	-50.45	-0.14	0.08	0.20	0.0	3.22	4.98
1216	0	0	-1.53	0.00	-50.45	-0.10	0.08	0.20	0.0	3.22	4.98
1115	0	6	-1.63	1.40	-50.46	-0.13	0.08	1.60	0.0	3.27	4.98
1220	0	6	-1.73	1.50	-50.46	-0.18	0.09	1.70	0.0	3.27	4.98
1118	0	9	-1.73	2.40	-50.46	-0.15	0.09	3.00	0.0	3.33	4.98
1223	0	9	-1.63	2.40	-50.46	-0.28	0.08	3.09	0.0	3.29	4.97
1121	0	12	-1.73	3.60	-50.46	-0.09	0.09	5.10	0.0	3.35	4.98
1226	0	12	-1.73	3.40	-50.46	-0.26	0.09	4.99	0.0	3.33	4.98
1124	10	0	-1.44	-8.86	-49.67	-3.06	0.06	-0.03	0.1	3.30	4.98
1229	10	0	-1.44	-8.76	-49.69	-3.17	0.08	0.07	0.1	3.24	4.97
1127	10	6	-1.64	-7.29	-49.95	-3.18	0.28	1.15	0.1	3.34	4.98
1232	10	6	-1.54	-7.28	-49.95	-3.27	0.28	1.15	0.1	3.29	4.97

TABLE 28.2

APPENDED HULL RESULTS, L/R = 0, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 12.5 knots											
1130	10	9	-1.64	-6.50	-50.09	-3.23	0.49	2.33	0.1	3.34	4.98
1235	10	9	-1.54	-6.50	-50.09	-3.31	0.48	2.33	0.1	3.32	4.98
1133	10	12	-1.73	-5.51	-50.26	-3.18	0.81	4.11	0.0	3.37	4.98
1238	10	12	-1.73	-5.51	-50.26	-3.29	0.83	4.20	0.0	3.34	4.98
1138	20	0	-1.35	-17.35	-47.38	-5.21	-0.06	-0.33	0.2	3.23	4.97
1241	20	0	-1.35	-17.35	-47.38	-5.22	-0.03	-0.24	0.2	3.20	4.98
1253	20	3	-1.35	-16.60	-47.66	-5.26	0.14	0.23	0.2	3.22	4.97
1141	20	6	-1.55	-15.76	-47.97	-5.26	0.26	0.51	0.2	3.29	4.98
1244	20	6	-1.45	-15.76	-47.97	-5.35	0.25	0.51	0.2	3.26	4.98
1144	20	9	-1.55	-14.91	-48.27	-5.31	0.53	1.26	0.2	3.33	4.98
1247	20	9	-1.55	-14.91	-48.27	-5.40	0.56	1.35	0.2	3.30	4.98
1147	20	12	-1.65	-13.97	-48.62	-5.37	1.01	2.57	0.2	3.35	4.97
1250	20	12	-1.55	-13.97	-48.62	-5.49	1.04	2.67	0.2	3.33	4.97
SPEED = 35 knots											
1113	0	0	-5.63	0.50	-50.72	-0.02	0.29	0.70	1.7	3.36	13.93
1217	0	0	-5.64	0.30	-50.73	-0.14	0.29	0.69	1.8	3.37	13.95
1218	0	0	-5.64	0.30	-50.73	-0.12	0.29	0.69	1.8	3.39	13.94
1116	0	6	-5.81	13.30	-50.83	1.04	0.28	-1.70	2.4	3.71	13.92
1221	0	6	-5.81	14.00	-50.83	1.23	0.28	-2.19	2.4	3.72	13.94
1119	0	9	-6.06	21.10	-50.92	2.06	0.28	-5.67	2.9	4.00	13.97
1224	0	9	-5.96	21.50	-50.91	2.37	0.27	-5.75	2.9	4.01	13.93
1122	0	12	-6.33	29.00	-51.04	3.52	0.27	-9.01	3.5	4.33	13.93
1227	0	12	-6.23	29.10	-51.03	3.87	0.27	-9.09	3.5	4.29	13.94
1125	10	0	-5.75	-9.50	-49.86	-2.75	-0.05	-1.95	1.9	3.46	13.94
1136	10	0	-5.75	-9.60	-49.84	-2.68	-0.05	-1.95	1.9	3.43	13.93
1230	10	0	-5.75	-9.31	-49.89	-2.76	-0.03	-1.85	1.9	3.41	13.94
1128	10	6	-5.41	3.88	-52.27	-1.18	-0.47	-4.10	2.4	3.64	13.93
1135	10	6	-5.41	3.88	-52.27	-1.18	-0.47	-4.10	2.4	3.64	13.92
1233	10	6	-5.51	4.47	-52.38	-0.97	-0.52	-4.39	2.4	3.64	13.92
1131	10	9	-5.27	9.68	-53.38	0.05	-1.33	-8.80	3.0	3.88	13.94
1236	10	9	-5.17	10.17	-53.46	0.37	-1.35	-8.88	3.0	3.81	13.94
1134	10	12	-5.50	14.59	-54.29	1.25	-1.66	-10.72	3.2	3.89	13.95
1239	10	12	-5.50	15.19	-54.39	1.67	-1.68	-10.79	3.2	3.85	13.92
1139	20	0	-5.97	-18.59	-47.28	-4.94	-0.43	-2.02	2.1	3.53	13.94
1242	20	0	-6.07	-18.31	-47.39	-4.85	-0.39	-1.92	2.1	3.49	13.95
1254	20	3	-5.70	-11.46	-49.90	-4.35	-1.04	-3.62	2.3	3.49	13.93
1142	20	6	-5.54	-3.86	-52.72	-3.33	-2.27	-6.91	2.7	3.74	13.92
1245	20	6	-5.44	-3.48	-52.85	-3.05	-2.30	-6.99	2.7	3.66	13.95
1145	20	9	-4.60	1.58	-54.71	-2.10	-3.85	-11.02	3.2	3.76	13.94
1248	20	9	-4.60	2.24	-54.95	-1.69	-3.87	-11.09	3.2	3.73	13.92
1148	20	12	-4.49	5.16	-55.99	-1.18	-4.07	-11.63	3.1	3.53	13.92
1214	20	12	-4.59	6.01	-56.30	-0.70	-4.13	-11.80	3.1	3.51	13.94
1251	20	12	-4.59	6.10	-56.34	-0.68	-4.19	-11.98	3.1	3.53	13.93

TABLE 29.1

APPENDED HULL RESULTS, L/R = 0.206, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 knots											
2274	-10	-6	0.47	8.66	-49.68	2.73	-0.05	-0.07	0.0	3.00	0.00
2216	-10	0	0.47	8.66	-49.68	2.72	-0.07	0.02	0.0	2.95	0.00
2241	-10	6	0.47	8.66	-49.68	2.77	-0.08	0.12	0.0	3.01	0.00
2251	-10	9	0.37	8.66	-49.68	2.72	-0.08	0.12	0.0	3.03	0.00
2271	-10	12	0.37	8.66	-49.68	2.70	-0.08	0.12	0.0	3.04	0.00
2280	0	-6	0.48	-0.10	-50.43	-0.54	-0.06	0.10	-0.1	2.94	0.00
2213	0	0	0.48	-0.20	-50.43	-0.56	-0.06	-0.00	-0.1	2.89	0.00
2245	0	6	0.48	-0.10	-50.43	-0.49	-0.06	-0.00	-0.1	2.95	0.00
2248	0	9	0.38	-0.10	-50.43	-0.50	-0.05	0.10	-0.1	2.95	0.00
2267	0	12	0.28	-0.10	-50.43	-0.52	-0.04	-0.00	-0.1	2.96	0.00
2283	10	-6	0.38	-8.86	-49.65	-3.72	-0.04	0.07	-0.1	2.92	0.00
2228	10	0	0.28	-8.66	-49.68	-4.24	-0.03	0.06	-0.1	2.88	0.00
2238	10	6	0.47	-8.86	-49.64	-3.70	-0.05	0.06	0.0	2.95	0.00
2254	10	9	0.47	-8.86	-49.64	-3.75	-0.05	0.06	0.0	2.96	0.00
2264	10	12	0.38	-8.86	-49.65	-3.79	-0.04	0.07	-0.1	2.95	0.00
2286	20	-6	0.38	-17.34	-47.35	-5.73	-0.03	0.05	-0.1	2.83	0.00
2232	20	0	0.38	-17.34	-47.35	-5.73	-0.07	-0.04	-0.1	2.80	0.00
2235	20	6	0.38	-17.34	-47.35	-5.67	-0.03	0.06	-0.1	2.82	0.00
2257	20	9	0.28	-17.34	-47.35	-5.75	-0.02	0.05	-0.1	2.87	0.00
2261	20	12	0.38	-17.34	-47.35	-5.71	-0.03	0.05	-0.1	2.86	0.00
SPEED = 12.5 knots											
2278	-10	-6	-1.14	7.48	-49.91	2.71	0.85	-4.58	0.2	3.40	4.98
2276	-10	-3	-1.19	8.76	-49.69	2.57	0.45	-2.34	0.3	3.46	4.96
2217	-10	0	-1.15	8.97	-49.66	2.44	0.46	-2.44	0.4	3.42	4.99
2242	-10	6	-1.25	10.34	-49.43	2.15	0.26	-1.28	0.6	3.61	4.98
2252	-10	9	-1.50	11.12	-49.30	1.97	0.16	-0.61	0.6	3.72	4.98
2272	-10	12	-1.75	12.29	-49.10	1.79	0.02	0.25	0.7	3.82	4.98
2281	0	-6	-1.33	-1.60	-50.46	-0.42	0.06	-5.28	0.1	3.41	4.98
2214	0	0	-1.13	0.10	-50.46	-0.65	0.04	-2.51	0.3	3.38	4.96
2246	0	6	-1.23	1.30	-50.47	-0.81	0.04	-1.54	0.4	3.55	4.99
2249	0	9	-1.48	2.19	-50.47	-0.88	0.05	-0.66	0.5	3.63	4.99
2268	0	12	-1.53	2.88	-50.48	-0.93	0.06	0.02	0.5	3.68	4.99
2284	10	-6	-1.43	-10.33	-49.41	-3.54	-0.89	-5.42	0.1	3.40	4.98
2229	10	0	-1.33	-8.47	-49.75	-4.09	-0.41	-2.62	0.3	3.39	4.96
2239	10	6	-1.24	-7.19	-49.98	-3.77	-0.24	-1.57	0.5	3.53	4.98
2243	10	6	-1.24	-7.20	-49.98	0.95	-0.19	-1.27	0.5	3.60	4.95
2255	10	9	-1.38	-6.50	-50.10	-3.79	-0.13	-0.99	0.5	3.60	5.00
2265	10	12	-1.43	-5.74	-50.24	-3.85	0.03	-0.12	0.5	3.63	4.97

TABLE 29.2

APPENDED HULL RESULTS, L/R = 0.206, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 12.5 knots											
2287	20	-6	-1.33	-18.76	-46.87	-5.76	-1.76	-5.01	0.1	3.31	4.98
2233	20	0	-1.23	-17.16	-47.45	-5.81	-0.97	-2.79	0.3	3.32	4.98
2236	20	6	-1.24	-15.57	-48.04	-5.95	-0.62	-1.81	0.5	3.45	4.99
2258	20	9	-1.40	-14.65	-48.39	-6.05	-0.52	-1.55	0.6	3.56	4.98
2262	20	12	-1.43	-13.81	-48.69	-6.05	-0.31	-1.00	0.5	3.58	4.98
SPEED = 35 knots											
2279	-10	-6	-4.87	-2.10	-51.96	1.08	1.76	-8.83	2.6	4.01	13.91
2277	-10	-3	-5.19	8.54	-50.06	1.17	1.85	-9.16	2.3	3.89	13.90
2218	-10	0	-4.84	10.29	-49.73	1.06	1.84	-9.20	2.3	3.84	13.89
2253	-10	9	-7.11	31.28	-46.19	0.87	1.53	-6.61	2.5	4.25	13.91
2273	-10	12	-7.17	41.33	-44.59	1.13	2.08	-9.92	3.4	4.82	13.89
2282	0	-6	-5.74	-13.73	-50.81	-1.02	0.28	-17.48	2.3	3.98	13.96
2215	0	0	-4.73	0.29	-50.74	-1.44	0.21	-12.30	2.2	3.72	13.88
2247	0	6	-5.21	14.00	-50.88	-1.43	0.21	-14.64	3.0	4.23	13.95
2250	0	9	-5.72	17.95	-50.87	-0.66	0.26	-7.55	2.7	4.13	13.97
2269	0	12	-8.07	27.47	-50.81	-0.34	0.47	2.82	1.6	3.85	13.90
2285	10	-6	-6.72	-24.64	-47.27	-2.87	-3.64	-22.63	2.1	3.99	13.94
2230	10	0	-5.22	-9.75	-49.82	-4.05	-2.38	-14.92	2.1	3.71	13.85
2240	10	6	-4.89	4.36	-52.38	-3.56	-2.51	-15.35	2.8	4.01	13.94
2244	10	6	-5.61	6.97	-52.92	-1.00	-1.96	-12.50	3.0	4.35	13.91
2256	10	9	-5.75	6.76	-52.74	-2.68	-0.89	-6.72	2.0	3.67	13.94
2266	10	12	-5.44	12.29	-53.74	-1.90	-1.14	-7.90	2.3	3.74	13.95
2289	20	-6	-6.82	-30.97	-42.82	-4.78	-8.08	-23.18	2.1	3.83	13.94
2234	20	0	-5.61	-17.90	-47.52	-6.13	-4.62	-13.45	2.1	3.69	13.91
2237	20	6	-5.34	-4.63	-52.38	-6.09	-4.80	-13.85	2.4	3.77	13.92
2260	20	9	-5.81	-1.55	-53.42	-4.90	-2.83	-8.63	1.7	3.40	13.94
2263	20	12	-5.84	3.71	-55.29	-4.26	-1.54	-5.12	1.4	3.19	13.92

TABLE 30

RUDDER EFFECTIVENESS RESULTS, L/R = 0, AXES B
 Displacement 135 long tons
 Roll = Yaw = 0 deg

Run No.	Rudder deg	δ	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
SPEED = 0 knots											
1215	0		0.10	0.00	-50.43	-0.10	-0.02	0.10	-0.3	2.81	0.00
1263	5		0.10	0.00	-50.43	-0.08	-0.02	0.10	-0.3	2.87	0.00
1259	10		0.10	0.00	-50.43	-0.09	-0.02	0.10	-0.3	2.88	0.00
1255	15		0.10	0.00	-50.43	-0.07	-0.02	0.10	-0.3	2.84	0.00
SPEED = 12.5 knots											
1210	0		-1.53	0.00	-50.45	-0.14	0.08	0.20	0.0	3.22	4.98
1265	5		-1.63	0.40	-50.46	-0.15	0.08	-0.60	0.0	3.21	4.98
1261	10		-1.63	0.60	-50.46	-0.19	0.08	-1.00	0.0	3.23	4.98
1256	15		-2.00	0.70	-50.45	-0.22	0.12	-1.30	-0.3	3.07	4.97
SPEED = 35 knots											
1217	0		-5.64	0.30	-50.73	-0.14	0.29	0.69	1.8	3.37	13.95
1264	5		-5.84	2.00	-50.74	-0.69	0.30	-3.84	1.8	3.37	13.95
1260	10		-6.04	2.80	-50.75	-0.85	0.32	-5.45	1.8	3.36	13.94
1262	10		-6.04	2.80	-50.75	-0.85	0.32	-5.45	1.8	3.37	13.92
1257	15		-8.83	3.80	-50.55	-1.20	0.58	-8.02	0.0	2.77	13.94
1258	15		-8.73	3.80	-50.55	-1.20	0.57	-7.92	0.0	2.77	13.94

TABLE 31

BARE HULL STATIC ROLL RESULTS, L/R = 0.206, AXES B
Speed = 0 knots

Run No.	Roll deg	Yaw deg	X lb	Y lb	Z lb	K lb-ft	M lb-ft	N lb-ft	Trim deg	TD inch	Speed fps
DISPLACEMENT = 135 long tons											
2554	-21	0	0.46	17.98	-47.12	4.99	-0.08	0.04	0.1	2.89	0.00
2553	-16	0	0.46	13.80	-48.50	4.12	-0.08	0.04	0.1	2.93	0.00
2552	-11	0	0.46	9.52	-49.52	3.00	-0.07	0.03	0.1	2.94	0.00
2551	-5	0	0.37	4.30	-50.25	1.21	-0.06	0.01	0.0	2.90	0.00
2550	-3	0	0.37	2.54	-50.37	0.51	-0.05	0.00	0.0	2.88	0.00
2555	0	0	0.47	-0.10	-50.43	-0.52	-0.06	-0.00	0.0	2.87	0.00
2543	0	0	0.37	-0.10	-50.43	-0.50	-0.05	-0.00	0.0	2.87	0.00
2544	5	0	0.37	-4.49	-50.23	-1.96	-0.05	0.08	0.0	2.87	0.00
2546	10	0	0.37	-8.86	-49.65	-3.75	-0.04	0.06	0.0	2.86	0.00
2545	10	0	0.37	-8.86	-49.65	-3.92	-0.04	0.06	0.0	2.86	0.00
2547	16	0	0.37	-14.00	-48.45	-5.09	-0.04	0.05	0.0	2.81	0.00
2548	20	0	0.38	-17.34	-47.35	-5.68	-0.03	0.06	-0.1	2.75	0.00
2549	21	0	0.28	-18.17	-47.04	-5.84	-0.06	-0.04	-0.1	2.74	0.00

DISPLACEMENT = 155 long tons

2541	-20	0	0.77	19.71	-54.44	5.27	-0.11	0.06	0.3	3.27	0.00
2540	-16	0	0.67	15.86	-55.68	4.43	-0.09	0.05	0.2	3.27	0.00
2539	-10	0	0.67	9.96	-57.03	2.82	-0.09	0.03	0.2	3.24	0.00
2538	-5	0	0.57	4.95	-57.69	1.16	-0.07	0.01	0.1	3.20	0.00
2542	-3	0	0.57	2.93	-57.82	0.43	-0.07	0.10	0.1	3.19	0.00
2532	0	0	0.47	-0.10	-57.90	-0.59	-0.06	-0.01	0.0	3.18	0.00
2533	5	0	0.47	-5.15	-57.67	-2.34	-0.06	0.08	0.0	3.17	0.00
2534	10	0	0.57	-10.15	-57.00	-4.02	-0.06	0.06	0.1	3.18	0.00
2535	16	0	0.57	-16.05	-55.63	-5.48	-0.09	-0.05	0.1	3.16	0.00
2536	20	0	0.57	-19.90	-54.37	-6.28	-0.06	0.04	0.1	3.12	0.00
2537	21	0	0.47	-20.84	-54.02	-6.47	-0.05	0.04	0.0	3.11	0.00

TABLE 32

NON-DIMENSIONAL BARE HULL RESULTS, L/R = 0, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 12.5 knots, $C_v = 0.809$, Volume FN = 0.908									
1326	-20	-6	-0.0697	-0.0303	-1.5288	0.1297	0.0020	-0.0324	0.0
1323	-10	-6	-0.0700	-0.0243	-1.5349	0.0763	0.0021	-0.0448	0.0
1329	0	-6	-0.0697	-0.0273	-1.5288	-0.0021	0.0019	-0.0491	0.1
1273	0	0	-0.0639	0.0000	-1.5349	-0.0026	0.0018	0.0026	0.0
1276	0	6	-0.0697	0.0303	-1.5288	-0.0039	0.0019	0.0646	0.1
1279	0	9	-0.0697	0.0515	-1.5288	-0.0034	0.0022	0.1086	0.0
1282	0	12	-0.0730	0.0883	-1.5349	-0.0005	0.0023	0.1661	0.0
1283	0	12	-0.0728	0.0849	-1.5288	-0.0012	0.0023	0.1629	0.0
1286	10	0	-0.0667	-0.0030	-1.5288	-0.0828	0.0017	0.0033	0.1
1290	10	6	-0.0700	0.0304	-1.5349	-0.0814	0.0019	0.0578	0.1
1293	10	9	-0.0697	0.0515	-1.5288	-0.0801	0.0019	0.0989	0.1
1296	10	12	-0.0728	0.0788	-1.5288	-0.0783	0.0023	0.1507	0.0
1299	20	0	-0.0637	-0.0030	-1.5288	-0.1354	0.0012	-0.0039	0.2
1302	20	6	-0.0697	0.0333	-1.5288	-0.1344	0.0015	0.0427	0.2
1307	20	9	-0.0730	0.0578	-1.5349	-0.1344	0.0017	0.0741	0.2
1310	20	12	-0.0730	0.0852	-1.5349	-0.1345	0.0020	0.1130	0.1
SPEED = 35 knots, $C_v = 2.266$, Volume FN = 2.541									
1327	-20	-6	-0.0310	-0.0371	-0.1951	0.0090	0.0009	-0.0005	2.0
1324	-10	-6	-0.0298	-0.0341	-0.1954	0.0013	0.0009	-0.0081	1.9
1274	0	0	-0.0291	0.0012	-0.1954	-0.0005	0.0009	0.0016	1.7
1319	0	3	-0.0294	0.0205	-0.1954	0.0031	0.0009	0.0122	1.9
1277	0	6	-0.0313	0.0429	-0.1948	0.0068	0.0008	0.0157	2.3
1280	0	9	-0.0333	0.0690	-0.1954	0.0118	0.0008	0.0107	2.8
1317	0	11	-0.0349	0.0865	-0.1957	0.0150	0.0008	0.0056	3.2
1284	0	12	-0.0360	0.0979	-0.1951	0.0170	0.0007	0.0012	3.5
1315	0	12	-0.0357	0.0974	-0.1957	0.0170	0.0007	0.0016	3.5
1287	10	0	-0.0302	-0.0019	-0.1954	-0.0097	0.0009	-0.0076	1.9
1288	10	0	-0.0299	-0.0019	-0.1957	-0.0097	0.0009	-0.0076	1.8
1321	10	3	-0.0294	0.0193	-0.1948	-0.0058	0.0008	0.0052	1.9
1291	10	6	-0.0298	0.0399	-0.1954	-0.0014	0.0008	0.0081	2.1
1294	10	9	-0.0303	0.0609	-0.1957	0.0043	0.0006	0.0001	2.8
1297	10	12	-0.0313	0.0784	-0.1948	0.0090	0.0006	-0.0006	3.0
1300	20	0	-0.0318	-0.0043	-0.1954	-0.0168	0.0009	-0.0089	2.1
1313	20	3	-0.0315	0.0191	-0.1962	-0.0138	0.0009	-0.0024	2.0
1305	20	6	-0.0310	0.0461	-0.1954	-0.0092	0.0007	-0.0055	2.4
1308	20	9	-0.0290	0.0696	-0.1951	-0.0037	0.0005	-0.0082	2.8
1311	20	12	-0.0279	0.0814	-0.1954	0.0006	0.0005	-0.0057	2.7

TABLE 33.1

NON-DIMENSIONAL BARE HULL RESULTS, $L/R = 0.206$, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 12.5 knots, $C_v = 0.809$, Volume FN = 0.908									
2201	-10	-6	-0.0631	-0.0423	-1.5288	0.0671	0.0010	-0.1189	0.3
2138	-10	0	-0.0657	-0.0029	-1.5288	0.0664	0.0009	-0.0472	0.4
2154	-10	6	-0.0746	0.0302	-1.5349	0.0666	0.0009	0.0013	0.6
2176	-10	9	-0.0783	0.0511	-1.5227	0.0569	0.0009	0.0215	0.7
2196	-10	12	-0.0860	0.0841	-1.5288	0.0568	0.0010	0.0468	0.8
2203	0	-6	-0.0606	-0.0521	-1.5411	-0.0111	0.0011	-0.1295	0.2
2134	0	0	-0.0651	-0.0026	-1.5166	-0.0074	0.0011	-0.0513	0.3
2150	0	6	-0.0722	0.0240	-1.5474	-0.0104	0.0010	0.0048	0.5
2151	0	6	-0.0719	0.0241	-1.5411	-0.0108	0.0010	0.0048	0.5
2173	0	9	-0.0742	0.0453	-1.5600	-0.0124	0.0011	0.0256	0.5
2193	0	12	-0.0803	0.0691	-1.5349	-0.0131	0.0012	0.0560	0.6
2206	10	-6	-0.0631	-0.0545	-1.5288	-0.0922	0.0012	-0.1278	0.2
2141	10	0	-0.0654	-0.0057	-1.5227	-0.0899	0.0011	-0.0508	0.3
2157	10	6	-0.0713	0.0241	-1.5288	-0.0838	0.0009	0.0029	0.5
2179	10	9	-0.0756	0.0481	-1.5288	-0.0871	0.0012	0.0207	0.5
2189	10	12	-0.0800	0.0690	-1.5288	-0.0875	0.0014	0.0488	0.5
2209	20	-6	-0.0601	-0.0514	-1.5288	-0.1510	0.0012	-0.1273	0.1
2144	20	0	-0.0657	-0.0029	-1.5288	-0.1450	0.0011	-0.0555	0.3
2161	20	6	-0.0743	0.0363	-1.5288	-0.1453	0.0011	-0.0146	0.5
2182	20	9	-0.0729	0.0634	-1.5349	-0.1459	0.0010	-0.0022	0.5
2186	20	12	-0.0796	0.0930	-1.5227	-0.1441	0.0014	0.0181	0.5

TABLE 33.2

NON-DIMENSIONAL BARE HULL RESULTS, L/R = 0.206, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 35 knots, $C_v = 2.266$, Volume FN = 2.541									
2199	-10	-6	-0.0284	-0.0397	-0.1951	-0.0005	0.0006	-0.0398	2.5
2139	-10	0	-0.0284	0.0010	-0.1929	0.0048	0.0006	-0.0192	2.4
2155	-10	6	-0.0332	0.0489	-0.1979	0.0061	0.0007	-0.0143	3.0
2177	-10	9	-0.0350	0.0800	-0.1962	0.0054	0.0005	-0.0278	3.8
2197	-10	12	-0.0379	0.1099	-0.1960	0.0048	0.0004	-0.0431	4.7
2204	0	-6	-0.0303	-0.0519	-0.1974	-0.0084	0.0008	-0.0685	2.2
2556	0	-6	-0.0276	-0.0503	-0.1948	-0.0084	0.0006	-0.0673	2.3
2136	0	0	-0.0280	-0.0048	-0.1954	-0.0039	0.0007	-0.0300	2.1
2557	0	0	-0.0283	-0.0032	-0.1948	-0.0040	0.0007	-0.0293	2.2
2152	0	6	-0.0300	0.0399	-0.1979	-0.0001	0.0006	-0.0185	2.8
2558	0	6	-0.0299	0.0410	-0.1948	-0.0003	0.0006	-0.0183	2.9
2174	0	9	-0.0313	0.0654	-0.1971	0.0012	0.0005	-0.0246	3.4
2194	0	12	-0.0329	0.0917	-0.1962	0.0028	0.0004	-0.0350	3.9
2559	0	12	-0.0334	0.0917	-0.1948	0.0027	0.0004	-0.0345	4.0
2212	10	-6	-0.0342	-0.0621	-0.1951	-0.0150	0.0011	-0.0850	2.1
2142	10	0	-0.0303	-0.0090	-0.1951	-0.0126	0.0009	-0.0378	1.8
2158	10	6	-0.0290	0.0348	-0.1968	-0.0077	0.0007	-0.0167	2.3
2180	10	9	-0.0290	0.0593	-0.1951	-0.0046	0.0005	-0.0200	2.9
2190	10	12	-0.0298	0.0769	-0.1962	-0.0019	0.0005	-0.0247	3.1
2191	10	12	-0.0297	0.0772	-0.1957	-0.0019	0.0005	-0.0247	3.1
2211	20	-6	-0.0342	-0.0515	-0.1948	-0.0231	0.0008	-0.0596	2.7
2145	20	0	-0.0306	-0.0066	-0.1946	-0.0202	0.0008	-0.0404	2.0
2162	20	6	-0.0297	0.0379	-0.1960	-0.0168	0.0008	-0.0233	2.1
2183	20	9	-0.0293	0.0646	-0.1968	-0.0132	0.0007	-0.0212	2.3
2187	20	12	-0.0265	0.0775	-0.1951	-0.0095	0.0005	-0.0190	2.3

TABLE 34

NON-DIMENSIONAL BARE HULL RESULTS, L/R = 0.412, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 12.5 knots, $C_v = 0.809$, Volume FN = 0.908									
3323	-10	-6	-0.0636	-0.0666	-1.5288	0.0709	0.0018	-0.2271	0.0
3320	-10	0	-0.0687	-0.0027	-1.5288	0.0661	0.0011	-0.1041	0.4
3338	-10	6	-0.0829	0.0393	-1.5288	0.0573	0.0011	-0.0429	0.7
3357	-10	9	-0.0885	0.0661	-1.5288	0.0512	0.0009	-0.0331	0.9
3360	-10	12	-0.0963	0.0985	-1.5166	0.0468	0.0009	-0.0258	1.1
3381	0	-6	-0.0608	-0.0854	-1.5349	-0.0094	0.0016	-0.2453	0.0
3382	0	-6	-0.0615	-0.0873	-1.5536	-0.0088	0.0016	-0.2456	0.0
3311	0	0	-0.0659	-0.0121	-1.5349	-0.0102	0.0012	-0.1140	0.3
3335	0	6	-0.0765	0.0303	-1.5227	-0.0124	0.0013	-0.0417	0.5
3354	0	9	-0.0821	0.0510	-1.5227	-0.0143	0.0011	-0.0240	0.7
3362	0	12	-0.0907	0.0744	-1.5227	-0.0162	0.0011	-0.0090	0.9
3388	10	-6	-0.0631	-0.0896	-1.5166	-0.0916	0.0018	-0.2391	0.0
3314	10	0	-0.0720	-0.0090	-1.5349	-0.0898	0.0015	-0.1160	0.3
3341	10	6	-0.0799	0.0363	-1.5288	-0.0889	0.0012	-0.0489	0.6
3350	10	9	-0.0851	0.0600	-1.5227	-0.0849	0.0013	-0.0285	0.7
3366	10	12	-0.0881	0.0805	-1.5288	-0.0851	0.0014	-0.0108	0.7
3393	20	-6	-0.0606	-0.0666	-1.5288	-0.1520	0.0015	-0.2098	0.0
3317	20	0	-0.0687	-0.0057	-1.5288	-0.1478	0.0012	-0.1201	0.3
3344	20	6	-0.0795	0.0515	-1.5227	-0.1461	0.0014	-0.0662	0.5
3347	20	9	-0.0890	0.0813	-1.5349	-0.1476	0.0014	-0.0541	0.7
3369	20	12	-0.0916	0.1141	-1.5349	-0.1480	0.0013	-0.0468	0.8
SPEED = 35 knots, $C_v = 2.266$, Volume FN = 2.541									
3375	-10	-6	-0.0294	-0.0514	-0.1934	-0.0020	0.0008	-0.0995	2.2
3321	-10	0	-0.0286	0.0035	-0.1943	0.0014	0.0006	-0.0506	2.6
3339	-10	6	-0.0331	0.0639	-0.1940	0.0006	0.0005	-0.0538	3.7
3358	-10	9	-0.0360	0.0967	-0.1932	-0.0006	0.0004	-0.0680	4.5
3361	-10	12	-0.0392	0.1321	-0.1934	-0.0029	0.0002	-0.0906	5.6
3312	0	0	-0.0291	-0.0089	-0.1974	-0.0062	0.0007	-0.0686	2.2
3336	0	6	-0.0305	0.0493	-0.1940	-0.0036	0.0005	-0.0498	3.1
3355	0	9	-0.0330	0.0774	-0.1968	-0.0028	0.0005	-0.0595	3.6
3364	0	12	-0.0346	0.1063	-0.1965	-0.0019	0.0004	-0.0713	4.3
3315	10	0	-0.0305	-0.0190	-0.1937	-0.0127	0.0011	-0.0872	1.4
3342	10	6	-0.0293	0.0377	-0.1940	-0.0099	0.0007	-0.0470	2.2
3351	10	9	-0.0296	0.0626	-0.1937	-0.0065	0.0006	-0.0445	2.6
3367	10	12	-0.0291	0.0818	-0.1932	-0.0030	0.0005	-0.0454	2.8
3395	20	-6	-0.0333	-0.0396	-0.1937	-0.0251	0.0008	-0.0802	2.6
3318	20	0	-0.0304	-0.0097	-0.1934	-0.0218	0.0009	-0.0823	1.7
3345	20	6	-0.0296	0.0367	-0.1954	-0.0177	0.0009	-0.0526	1.6
3348	20	9	-0.0284	0.0595	-0.1934	-0.0139	0.0009	-0.0430	1.5
3371	20	12	-0.0278	0.0805	-0.1960	-0.0099	0.0009	-0.0340	1.3

TABLE 35

SUPPLEMENTAL NON-DIMENSIONAL BARE HULL RESULTS, L/R = 0.412, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg	Cv
SPEED Cv = 0.48 to 1.7										
3429	0	-5	-0.0645	-0.0688	-1.5536	-0.0101	0.0018	-0.2144	0.0	0.804
3434	0	-5	-0.0670	-0.0720	-1.0602	-0.0077	0.0017	-0.2355	0.5	0.974
3430	0	-5	-0.0653	-0.0706	-0.7872	-0.0080	0.0011	-0.2291	1.3	1.130
3431	0	-5	-0.0501	-0.0682	-0.4629	-0.0105	0.0009	-0.1859	1.9	1.474
3433	0	-5	-0.0397	-0.0784	-0.3088	-0.0082	0.0013	-0.1783	1.3	1.804
3441	0	-6	-0.0501	-0.0567	-4.4467	-0.0366	-0.0012	-0.1796	-0.2	0.476
3435	0	-6	-0.0608	-0.0824	-1.5349	-0.0118	0.0016	-0.2427	0.0	0.809
3440	0	-6	-0.0647	-0.0883	-1.0567	-0.0090	0.0017	-0.2738	0.4	0.975
3407	-10	-6	-0.0655	-0.0690	-0.7694	0.0301	0.0010	-0.2259	1.4	1.143
3405	0	-6	-0.0653	-0.0853	-0.7672	-0.0081	0.0011	-0.2606	1.4	1.145
3412	0	-6	-0.0657	-0.0862	-0.7716	-0.0082	0.0012	-0.2621	1.3	1.142
3437	0	-6	-0.0648	-0.0856	-0.7607	-0.0095	0.0012	-0.2597	1.3	1.150
3409	10	-6	-0.0670	-0.0919	-0.7694	-0.0503	0.0013	-0.2736	1.3	1.143
3411	20	-6	-0.0716	-0.0568	-0.7694	-0.0830	0.0013	-0.2162	1.4	1.143
3384	0	-6	-0.0521	-0.0796	-0.5056	-0.0099	0.0008	-0.2166	1.9	1.410
3438	0	-6	-0.0509	-0.0834	-0.4619	-0.0119	0.0009	-0.2110	1.9	1.475
3385	0	-6	-0.0427	-0.0930	-0.3630	-0.0091	0.0011	-0.2108	1.5	1.664
3390	10	-6	-0.0448	-0.0952	-0.3492	-0.0269	0.0012	-0.2058	1.6	1.697
3394	20	-6	-0.0469	-0.0616	-0.3499	-0.0411	0.0011	-0.1536	1.9	1.695

TABLE 36.1

NON-DIMENSIONAL BARE HULL RESULTS, $L/R = 0.206$, AXES A
Displacement 155 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 12.5 knots, $C_v = 0.809$, Volume FN = 0.887									
2530	-10	-6	-0.0725	-0.0457	-1.7623	0.0757	0.0010	-0.1376	0.4
2462	-10	0	-0.0772	0.0035	-1.7412	0.0680	0.0010	-0.0522	0.5
2480	-10	6	-0.0861	0.0393	-1.7482	0.0630	0.0010	-0.0015	0.7
2483	-10	9	-0.0946	0.0635	-1.7694	0.0615	0.0014	0.0240	0.7
2507	-10	12	-0.1068	0.1050	-1.7482	0.0639	0.0013	0.0538	1.0
2527	0	-6	-0.0695	-0.0548	-1.7623	-0.0133	0.0011	-0.1497	0.3
2459	0	0	-0.0769	0.0006	-1.7343	-0.0123	0.0013	-0.0537	0.4
2477	0	6	-0.0848	0.0332	-1.7838	-0.0155	0.0011	0.0021	0.6
2486	0	9	-0.0915	0.0543	-1.7694	-0.0150	0.0015	0.0278	0.6
2504	0	12	-0.1003	0.0852	-1.7910	-0.0154	0.0017	0.0619	0.7
2524	10	-6	-0.0722	-0.0605	-1.7552	-0.1032	0.0012	-0.1457	0.3
2465	10	0	-0.0781	-0.0060	-1.7623	-0.0979	0.0013	-0.0536	0.4
2474	10	6	-0.0838	0.0363	-1.7623	-0.0945	0.0013	0.0003	0.5
2490	10	9	-0.0885	0.0574	-1.7694	-0.0942	0.0016	0.0234	0.5
2511	10	12	-0.0951	0.0871	-1.7552	-0.0958	0.0015	0.0538	0.7
2521	20	-6	-0.0725	-0.0579	-1.7623	-0.1620	0.0012	-0.1456	0.3
2468	20	0	-0.0754	-0.0031	-1.7694	-0.1643	0.0011	-0.0610	0.4
2471	20	6	-0.0834	0.0454	-1.7552	-0.1614	0.0010	-0.0146	0.6
2493	20	9	-0.0900	0.0751	-1.7412	-0.1608	0.0014	0.0006	0.6
2514	20	12	-0.0951	0.1084	-1.7552	-0.1576	0.0014	0.0234	0.7

TABLE 36.2

NON-DIMENSIONAL BARE HULL RESULTS, L/R = 0.206, AXES A
Displacement 155 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 35 knots, $C_v = 2.266$, Volume FN = 2.484									
2531	-10	-6	-0.0327	-0.0463	-0.2240	-0.0008	0.0006	-0.0397	3.0
2463	-10	0	-0.0327	0.0014	-0.2243	0.0044	0.0007	-0.0228	2.7
2481	-10	6	-0.0366	0.0569	-0.2247	0.0058	0.0006	-0.0197	3.5
2484	-10	9	-0.0400	0.0893	-0.2250	0.0057	0.0005	-0.0307	4.3
2508	-10	12	-0.0434	0.1222	-0.2237	0.0056	0.0003	-0.0446	5.4
2528	0	-6	-0.0352	-0.0593	-0.2256	-0.0093	0.0009	-0.0727	2.5
2460	0	0	-0.0320	-0.0034	-0.2250	-0.0046	0.0007	-0.0334	2.5
2478	0	6	-0.0341	0.0492	-0.2256	-0.0006	0.0005	-0.0239	3.3
2487	0	9	-0.0360	0.0764	-0.2266	0.0008	0.0005	-0.0316	3.8
2505	0	12	-0.0383	0.1037	-0.2250	0.0024	0.0003	-0.0406	4.5
2525	10	-6	-0.0385	-0.0700	-0.2243	-0.0173	0.0011	-0.0942	2.4
2466	10	0	-0.0341	-0.0082	-0.2256	-0.0133	0.0010	-0.0401	2.0
2475	10	6	-0.0326	0.0448	-0.2240	-0.0089	0.0007	-0.0236	2.7
2491	10	9	-0.0336	0.0709	-0.2240	-0.0057	0.0006	-0.0218	3.0
2512	10	12	-0.0332	0.0891	-0.2227	-0.0030	0.0004	-0.0316	3.6
2522	20	-6	-0.0399	-0.0630	-0.2234	-0.0252	0.0010	-0.0773	2.9
2469	20	0	-0.0351	-0.0057	-0.2247	-0.0228	0.0009	-0.0469	2.3
2519	20	0	-0.0351	-0.0064	-0.2247	-0.0222	0.0009	-0.0472	2.3
2472	20	6	-0.0333	0.0487	-0.2234	-0.0179	0.0008	-0.0289	2.4
2517	20	6	-0.0340	0.0472	-0.2250	-0.0175	0.0008	-0.0284	2.4
2494	20	9	-0.0327	0.0769	-0.2234	-0.0144	0.0007	-0.0255	2.6
2515	20	12	-0.0314	0.0922	-0.2256	-0.0102	0.0005	-0.0250	2.8

TABLE 37.1

NON-DIMENSIONAL APPENDED HULL RESULTS, L/R = 0, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 12.5 knots, $C_v = 0.809$, Volume FN = 0.908									
1112	0	0	-0.0667	0.0000	-1.5288	0.0000	0.0020	0.0052	0.0
1210	0	0	-0.0667	0.0000	-1.5288	-0.0036	0.0020	0.0052	0.0
1216	0	0	-0.0667	0.0000	-1.5288	-0.0026	0.0020	0.0052	0.0
1115	0	6	-0.0697	0.0424	-1.5288	-0.0029	0.0022	0.0413	0.0
1220	0	6	-0.0728	0.0455	-1.5288	-0.0040	0.0023	0.0439	0.0
1118	0	9	-0.0728	0.0728	-1.5288	-0.0030	0.0023	0.0775	0.0
1223	0	9	-0.0700	0.0730	-1.5349	-0.0061	0.0022	0.0804	0.0
1121	0	12	-0.0728	0.1091	-1.5288	-0.0006	0.0023	0.1318	0.0
1226	0	12	-0.0728	0.1031	-1.5288	-0.0051	0.0023	0.1292	0.0
1124	10	0	-0.0667	-0.0030	-1.5288	-0.0792	0.0017	0.0007	0.1
1229	10	0	-0.0670	0.0000	-1.5349	-0.0822	0.0017	0.0033	0.1
1127	10	6	-0.0728	0.0455	-1.5288	-0.0818	0.0020	0.0317	0.1
1232	10	6	-0.0700	0.0457	-1.5349	-0.0844	0.0019	0.0318	0.1
1130	10	9	-0.0728	0.0697	-1.5288	-0.0827	0.0020	0.0627	0.1
1235	10	9	-0.0697	0.0697	-1.5288	-0.0848	0.0019	0.0627	0.1
1133	10	12	-0.0728	0.1000	-1.5288	-0.0807	0.0023	0.1093	0.0
1238	10	12	-0.0728	0.1000	-1.5288	-0.0835	0.0023	0.1119	0.0
1138	20	0	-0.0670	-0.0030	-1.5349	-0.1354	0.0014	-0.0064	0.2
1241	20	0	-0.0667	-0.0030	-1.5288	-0.1352	0.0014	-0.0038	0.2
1253	20	3	-0.0670	0.0213	-1.5349	-0.1364	0.0014	0.0091	0.2
1141	20	6	-0.0728	0.0485	-1.5288	-0.1357	0.0017	0.0169	0.2
1244	20	6	-0.0697	0.0485	-1.5288	-0.1380	0.0015	0.0169	0.2
1144	20	9	-0.0728	0.0758	-1.5288	-0.1368	0.0017	0.0376	0.2
1247	20	9	-0.0728	0.0758	-1.5288	-0.1391	0.0017	0.0402	0.2
1147	20	12	-0.0761	0.1065	-1.5349	-0.1382	0.0019	0.0741	0.2
1250	20	12	-0.0730	0.1065	-1.5349	-0.1413	0.0017	0.0767	0.2

TABLE 37.2

NON-DIMENSIONAL APPENDED HULL RESULTS, L/R = 0, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 35 knots, $C_v = 2.266$, Volume FN = 2.541									
1113	0	0	-0.0302	0.0019	-0.1954	0.0000	0.0010	0.0023	1.7
1217	0	0	-0.0305	0.0012	-0.1948	-0.0004	0.0010	0.0023	1.8
1218	0	0	-0.0306	0.0012	-0.1951	-0.0003	0.0010	0.0023	1.8
1116	0	6	-0.0334	0.0516	-0.1957	0.0031	0.0009	-0.0058	2.4
1221	0	6	-0.0333	0.0542	-0.1951	0.0036	0.0009	-0.0074	2.4
1119	0	9	-0.0358	0.0813	-0.1943	0.0056	0.0009	-0.0190	2.9
1224	0	9	-0.0356	0.0833	-0.1954	0.0066	0.0009	-0.0195	2.9
1122	0	12	-0.0391	0.1124	-0.1954	0.0094	0.0009	-0.0306	3.5
1227	0	12	-0.0387	0.1126	-0.1951	0.0105	0.0009	-0.0309	3.5
1125	10	0	-0.0313	-0.0027	-0.1951	-0.0093	0.0010	-0.0059	1.9
1136	10	0	-0.0314	-0.0031	-0.1954	-0.0092	0.0010	-0.0060	1.9
1230	10	0	-0.0313	-0.0019	-0.1951	-0.0094	0.0010	-0.0056	1.9
1128	10	6	-0.0318	0.0500	-0.1954	-0.0047	0.0008	-0.0134	2.4
1135	10	6	-0.0318	0.0501	-0.1957	-0.0047	0.0008	-0.0134	2.4
1233	10	6	-0.0322	0.0524	-0.1957	-0.0040	0.0008	-0.0144	2.4
1131	10	9	-0.0333	0.0727	-0.1951	-0.0017	0.0007	-0.0293	3.0
1236	10	9	-0.0329	0.0747	-0.1951	-0.0007	0.0007	-0.0297	3.0
1134	10	12	-0.0348	0.0919	-0.1948	0.0016	0.0007	-0.0359	3.2
1239	10	12	-0.0349	0.0947	-0.1957	0.0030	0.0007	-0.0364	3.2
1139	20	0	-0.0329	-0.0050	-0.1951	-0.0166	0.0009	-0.0059	2.1
1242	20	0	-0.0332	-0.0039	-0.1948	-0.0163	0.0010	-0.0056	2.1
1254	20	3	-0.0325	0.0244	-0.1954	-0.0150	0.0009	-0.0116	2.3
1142	20	6	-0.0334	0.0559	-0.1957	-0.0124	0.0008	-0.0233	2.7
1245	20	6	-0.0328	0.0572	-0.1948	-0.0115	0.0008	-0.0236	2.7
1145	20	9	-0.0313	0.0782	-0.1951	-0.0096	0.0005	-0.0380	3.2
1248	20	9	-0.0314	0.0811	-0.1957	-0.0083	0.0005	-0.0384	3.2
1148	20	12	-0.0307	0.0931	-0.1957	-0.0066	0.0005	-0.0404	3.1
1214	20	12	-0.0310	0.0963	-0.1951	-0.0051	0.0005	-0.0410	3.1
1251	20	12	-0.0310	0.0969	-0.1954	-0.0051	0.0005	-0.0417	3.1

TABLE 38.1

NON-DIMENSIONAL APPENDED HULL RESULTS, L/R = 0.206, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 12.5 knots, $C_v = 0.809$, Volume FN = 0.908									
2278	-10	-6	-0.0601	-0.0393	-1.5288	0.0681	0.0011	-0.1215	0.2
2276	-10	-3	-0.0649	-0.0001	-1.5411	0.0658	0.0011	-0.0632	0.3
2217	-10	0	-0.0654	0.0063	-1.5227	0.0616	0.0009	-0.0652	0.4
2242	-10	6	-0.0743	0.0484	-1.5288	0.0548	0.0009	-0.0352	0.6
2252	-10	9	-0.0817	0.0724	-1.5288	0.0505	0.0013	-0.0176	0.6
2272	-10	12	-0.0921	0.1084	-1.5288	0.0465	0.0016	0.0050	0.7
2281	0	-6	-0.0631	-0.0484	-1.5288	-0.0129	0.0015	-0.1363	0.1
2214	0	0	-0.0632	0.0030	-1.5411	-0.0180	0.0010	-0.0652	0.3
2246	0	6	-0.0680	0.0393	-1.5227	-0.0218	0.0010	-0.0393	0.4
2249	0	9	-0.0783	0.0662	-1.5227	-0.0230	0.0014	-0.0166	0.5
2268	0	12	-0.0796	0.0869	-1.5227	-0.0239	0.0015	0.0011	0.5
2284	10	-6	-0.0662	-0.0484	-1.5288	-0.0936	0.0017	-0.1408	0.1
2229	10	0	-0.0693	0.0091	-1.5411	-0.1079	0.0013	-0.0672	0.3
2239	10	6	-0.0713	0.0484	-1.5288	-0.0985	0.0009	-0.0389	0.5
2243	10	6	-0.0722	0.0486	-1.5474	0.0241	0.0010	-0.0341	0.5
2255	10	9	-0.0750	0.0690	-1.5166	-0.0978	0.0012	-0.0235	0.5
2265	10	12	-0.0773	0.0935	-1.5349	-0.0999	0.0013	-0.0008	0.5
2287	20	-6	-0.0631	-0.0484	-1.5288	-0.1511	0.0014	-0.1350	0.1
2233	20	0	-0.0657	0.0032	-1.5288	-0.1516	0.0011	-0.0737	0.3
2236	20	6	-0.0710	0.0544	-1.5227	-0.1544	0.0009	-0.0458	0.5
2258	20	9	-0.0786	0.0845	-1.5288	-0.1574	0.0011	-0.0386	0.6
2262	20	12	-0.0769	0.1114	-1.5288	-0.1569	0.0012	-0.0236	0.5

TABLE 38.2

NON-DIMENSIONAL APPENDED HULL RESULTS, L/R = 0.206, AXES A
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 35 knots, $C_v = 2.266$, Volume FN = 2.541									
2279	-10	-6	-0.0305	-0.0431	-0.1960	0.0018	0.0007	-0.0300	2.6
2277	-10	-3	-0.0307	-0.0011	-0.1962	0.0022	0.0008	-0.0312	2.3
2218	-10	0	-0.0294	0.0059	-0.1965	0.0019	0.0007	-0.0313	2.3
2253	-10	9	-0.0388	0.0885	-0.1960	0.0016	0.0012	-0.0226	2.5
2273	-10	12	-0.0423	0.1284	-0.1965	0.0013	0.0011	-0.0339	3.4
2282	0	-6	-0.0326	-0.0530	-0.1946	-0.0064	0.0009	-0.0573	2.3
2215	0	0	-0.0286	0.0011	-0.1968	-0.0069	0.0007	-0.0406	2.2
2247	0	6	-0.0330	0.0541	-0.1948	-0.0079	0.0007	-0.0478	3.0
2250	0	9	-0.0338	0.0692	-0.1943	-0.0037	0.0009	-0.0246	2.7
2269	0	12	-0.0395	0.1069	-0.1962	-0.0007	0.0015	0.0094	1.6
2285	10	-6	-0.0358	-0.0621	-0.1951	-0.0132	0.0011	-0.0751	2.1
2230	10	0	-0.0303	-0.0037	-0.1977	-0.0160	0.0008	-0.0498	2.1
2240	10	6	-0.0311	0.0518	-0.1951	-0.0149	0.0007	-0.0505	2.8
2244	10	6	-0.0347	0.0624	-0.1960	-0.0060	0.0008	-0.0416	3.0
2256	10	9	-0.0317	0.0612	-0.1951	-0.0099	0.0009	-0.0219	2.0
2266	10	12	-0.0314	0.0828	-0.1948	-0.0077	0.0008	-0.0259	2.3
2289	20	-6	-0.0362	-0.0559	-0.1951	-0.0198	0.0011	-0.0801	2.1
2234	20	0	-0.0316	-0.0022	-0.1960	-0.0227	0.0009	-0.0461	2.1
2237	20	6	-0.0316	0.0526	-0.1957	-0.0228	0.0008	-0.0473	2.4
2260	20	9	-0.0309	0.0651	-0.1951	-0.0175	0.0010	-0.0292	1.7
2263	20	12	-0.0301	0.0869	-0.1957	-0.0148	0.0010	-0.0171	1.4

TABLE 39

NON-DIMENSIONAL BARE HULL RESULTS, L/R = 0, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 12.5 knots, $C_v = 0.809$, Volume FN = 0.908									
1326	-20	-6	-0.0494	0.4947	-1.4477	0.1301	-0.4405	-0.0281	0.0
1323	-10	-6	-0.0496	0.2427	-1.5166	0.0769	-0.2269	-0.0428	0.0
1329	0	-6	-0.0468	-0.0273	-1.5297	-0.0014	-0.0386	-0.0491	0.1
1273	0	0	-0.0436	0.0000	-1.5357	-0.0026	0.7041	0.0026	0.0
1276	0	6	-0.0468	0.0303	-1.5297	-0.0049	0.0294	0.0646	0.1
1279	0	9	-0.0494	0.0515	-1.5296	-0.0049	0.0198	0.1085	0.0
1282	0	12	-0.0527	0.0883	-1.5358	-0.0027	0.0141	0.1661	0.0
1283	0	12	-0.0525	0.0849	-1.5296	-0.0034	0.0143	0.1628	0.0
1286	10	0	-0.0437	-0.2686	-1.5058	-0.0828	1.1854	0.0017	0.1
1290	10	6	-0.0470	-0.2367	-1.5178	-0.0823	0.2107	0.0554	0.1
1293	10	9	-0.0468	-0.2149	-1.5154	-0.0816	0.1961	0.0959	0.1
1296	10	12	-0.0525	-0.1880	-1.5201	-0.0803	0.1922	0.1470	0.0
1299	20	0	-0.0380	-0.5260	-1.4364	-0.1353	0.1569	-0.0062	0.2
1302	20	6	-0.0441	-0.4919	-1.4489	-0.1351	0.4077	0.0375	0.2
1307	20	9	-0.0473	-0.4710	-1.4631	-0.1356	0.3912	0.0669	0.2
1310	20	12	-0.0500	-0.4452	-1.4724	-0.1361	0.3841	0.1037	0.1
SPEED = 35 knots, $C_v = 2.266$, Volume FN = 2.541									
1327	-20	-6	-0.0215	0.0323	-0.1972	0.0090	4.0007	0.0002	2.0
1324	-10	-6	-0.0207	0.0006	-0.1995	0.0017	-0.2894	-0.0078	1.9
1274	0	0	-0.0206	0.0012	-0.1965	-0.0005	0.5541	0.0016	1.7
1319	0	3	-0.0203	0.0205	-0.1965	0.0025	0.0698	0.0123	1.9
1277	0	6	-0.0208	0.0429	-0.1962	0.0060	0.0524	0.0160	2.3
1280	0	9	-0.0211	0.0690	-0.1971	0.0111	0.0696	0.0114	2.8
1317	0	11	-0.0213	0.0865	-0.1976	0.0146	0.1132	0.0066	3.2
1284	0	12	-0.0214	0.0979	-0.1972	0.0169	0.2891	0.0025	3.5
1315	0	12	-0.0211	0.0974	-0.1978	0.0169	0.2472	0.0028	3.5
1287	10	0	-0.0211	-0.0360	-0.1933	-0.0093	0.0645	-0.0081	1.9
1288	10	0	-0.0211	-0.0361	-0.1935	-0.0093	0.0631	-0.0081	1.8
1321	10	3	-0.0203	-0.0150	-0.1964	-0.0061	0.3589	0.0047	1.9
1291	10	6	-0.0200	0.0052	-0.2006	-0.0018	0.2813	0.0078	2.1
1294	10	9	-0.0181	0.0258	-0.2048	0.0043	2.6584	0.0002	2.8
1297	10	12	-0.0184	0.0431	-0.2071	0.0090	-3.8538	-0.0002	3.0
1300	20	0	-0.0220	-0.0713	-0.1834	-0.0164	0.2658	-0.0095	2.1
1313	20	3	-0.0220	-0.0496	-0.1921	-0.0137	0.0675	-0.0032	2.0
1305	20	6	-0.0202	-0.0240	-0.2007	-0.0088	0.2298	-0.0059	2.4
1308	20	9	-0.0168	-0.0018	-0.2085	-0.0032	0.2975	-0.0081	2.8
1311	20	12	-0.0161	0.0092	-0.2127	0.0009	0.2711	-0.0054	2.7

TABLE 40.1

NON-DIMENSIONAL BARE HULL RESULTS, $L/R = 0.206$, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 12.5 knots, $C_v = 0.809$, Volume FN = 0.908									
2201	-10	-6	-0.0348	0.2239	-1.5138	0.0693	-0.1849	-0.1157	0.3
2138	-10	0	-0.0347	0.2628	-1.5071	0.0673	-0.1961	-0.0450	0.4
2154	-10	6	-0.0382	0.2965	-1.5077	0.0665	0.1179	0.0030	0.6
2176	-10	9	-0.0395	0.3150	-1.4921	0.0563	-0.1379	0.0228	0.7
2196	-10	12	-0.0444	0.3486	-1.4927	0.0555	-0.1542	0.0478	0.8
2203	0	-6	-0.0347	-0.0521	-1.5419	-0.0089	-0.0083	-0.1297	0.2
2134	0	0	-0.0371	-0.0026	-1.5175	-0.0064	-0.0221	-0.0514	0.3
2150	0	6	-0.0382	0.0240	-1.5486	-0.0105	0.2119	0.0046	0.5
2151	0	6	-0.0380	0.0241	-1.5423	-0.0109	0.2123	0.0046	0.5
2173	0	9	-0.0399	0.0453	-1.5612	-0.0129	0.0420	0.0254	0.5
2193	0	12	-0.0439	0.0691	-1.5364	-0.0144	0.0220	0.0556	0.6
2206	10	-6	-0.0375	-0.3193	-1.4969	-0.0901	0.1665	-0.1275	0.2
2141	10	0	-0.0372	-0.2702	-1.4995	-0.0889	0.1543	-0.0518	0.3
2157	10	6	-0.0376	-0.2419	-1.5109	-0.0839	1.2576	0.0009	0.5
2179	10	9	-0.0420	-0.2183	-1.5152	-0.0875	0.2430	0.0182	0.5
2189	10	12	-0.0463	-0.1978	-1.5189	-0.0885	0.2084	0.0459	0.5
2209	20	-6	-0.0371	-0.5715	-1.4197	-0.1491	0.3531	-0.1221	0.1
2144	20	0	-0.0374	-0.5259	-1.4365	-0.1440	0.3432	-0.0551	0.3
2161	20	6	-0.0407	-0.4892	-1.4502	-0.1450	0.2974	-0.0171	0.5
2182	20	9	-0.0391	-0.4658	-1.4652	-0.1459	0.1707	-0.0054	0.5
2186	20	12	-0.0461	-0.4339	-1.4639	-0.1445	0.4720	0.0135	0.5

TABLE 40.2

NON-DIMENSIONAL BARE HULL RESULTS, L/R = 0.206, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 35 knots, $C_v = 2.266$, Volume FN = 2.541									
2199	-10	-6	-0.0173	-0.0050	-0.2003	0.0017	-0.1918	-0.0391	2.5
2139	-10	0	-0.0178	0.0347	-0.1910	0.0059	-0.2113	-0.0185	2.4
2155	-10	6	-0.0201	0.0829	-0.1882	0.0070	-0.2279	-0.0136	3.0
2177	-10	9	-0.0193	0.1133	-0.1815	0.0076	-0.1970	-0.0268	3.8
2197	-10	12	-0.0191	0.1427	-0.1766	0.0089	-0.1865	-0.0417	4.7
2204	0	-6	-0.0200	-0.0519	-0.1987	-0.0048	-0.0116	-0.0688	2.2
2556	0	-6	-0.0171	-0.0503	-0.1960	-0.0048	-0.0092	-0.0676	2.3
2136	0	0	-0.0183	-0.0048	-0.1965	-0.0024	-0.0236	-0.0301	2.1
2557	0	0	-0.0182	-0.0032	-0.1960	-0.0025	-0.0237	-0.0294	2.2
2152	0	6	-0.0177	0.0399	-0.1994	0.0011	-0.0315	-0.0185	2.8
2558	0	6	-0.0174	0.0410	-0.1963	0.0009	-0.0306	-0.0182	2.9
2174	0	9	-0.0169	0.0654	-0.1988	0.0030	-0.0188	-0.0245	3.4
2194	0	12	-0.0168	0.0917	-0.1983	0.0056	-0.0114	-0.0347	3.9
2559	0	12	-0.0171	0.0917	-0.1969	0.0055	-0.0118	-0.0341	4.0
2212	10	-6	-0.0244	-0.0953	-0.1828	-0.0107	0.1636	-0.0845	2.1
2142	10	0	-0.0216	-0.0430	-0.1917	-0.0109	0.1514	-0.0379	1.8
2158	10	6	-0.0185	-0.0001	-0.2011	-0.0068	0.1351	-0.0169	2.3
2180	10	9	-0.0164	0.0242	-0.2039	-0.0033	0.1512	-0.0200	2.9
2190	10	12	-0.0165	0.0414	-0.2081	-0.0002	0.1568	-0.0245	3.1
2191	10	12	-0.0164	0.0418	-0.2076	-0.0002	0.1569	-0.0245	3.1
2211	20	-6	-0.0224	-0.1157	-0.1671	-0.0194	0.3487	-0.0575	2.7
2145	20	0	-0.0212	-0.0732	-0.1817	-0.0182	0.3410	-0.0391	2.0
2162	20	6	-0.0199	-0.0318	-0.1983	-0.0156	0.3288	-0.0229	2.1
2183	20	9	-0.0187	-0.0071	-0.2082	-0.0120	0.3299	-0.0208	2.3
2187	20	12	-0.0160	0.0057	-0.2109	-0.0084	0.3340	-0.0185	2.3

TABLE 41

NON-DIMENSIONAL BARE HULL RESULTS, L/R = 0.412, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 12.5 knots, $C_v = 0.809$, Volume FN = 0.908									
3323	-10	-6	-0.0433	0.2000	-1.5178	0.0739	-0.1844	-0.2224	0.0
3320	-10	0	-0.0377	0.2630	-1.5071	0.0682	-0.1869	-0.1010	0.4
3338	-10	6	-0.0439	0.3044	-1.5003	0.0584	-0.2042	-0.0406	0.7
3357	-10	9	-0.0442	0.3309	-1.4960	0.0521	-0.2071	-0.0309	0.9
3360	-10	12	-0.0471	0.3607	-1.4787	0.0476	-0.2157	-0.0237	1.1
3381	0	-6	-0.0404	-0.0854	-1.5356	-0.0062	-0.0066	-0.2454	0.0
3382	0	-6	-0.0408	-0.0873	-1.5543	-0.0055	-0.0067	-0.2457	0.0
3311	0	0	-0.0375	-0.0121	-1.5359	-0.0081	-0.0101	-0.1142	0.3
3335	0	6	-0.0430	0.0303	-1.5240	-0.0114	-0.0306	-0.0420	0.5
3354	0	9	-0.0433	0.0510	-1.5243	-0.0136	-0.0451	-0.0244	0.7
3362	0	12	-0.0466	0.0744	-1.5247	-0.0159	-0.1159	-0.0095	0.9
3388	10	-6	-0.0430	-0.3517	-1.4787	-0.0884	0.1688	-0.2369	0.0
3314	10	0	-0.0436	-0.2756	-1.5111	-0.0876	0.1633	-0.1161	0.3
3341	10	6	-0.0436	-0.2300	-1.5133	-0.0878	0.1523	-0.0505	0.6
3350	10	9	-0.0463	-0.2056	-1.5116	-0.0841	0.1343	-0.0304	0.7
3366	10	12	-0.0492	-0.1865	-1.5213	-0.0848	0.0657	-0.0130	0.7
3393	20	-6	-0.0403	-0.5857	-1.4144	-0.1492	0.3559	-0.1995	0.0
3317	20	0	-0.0404	-0.5286	-1.4356	-0.1456	0.3525	-0.1158	0.3
3344	20	6	-0.0460	-0.4729	-1.4497	-0.1446	0.3417	-0.0657	0.5
3347	20	9	-0.0498	-0.4492	-1.4718	-0.1462	0.3371	-0.0548	0.7
3369	20	12	-0.0498	-0.4184	-1.4832	-0.1467	0.3355	-0.0482	0.8
SPEED = 35 knots, $C_v = 2.266$, Volume FN = 2.541									
3375	-10	-6	-0.0194	-0.0168	-0.2007	0.0032	-0.1842	-0.0978	2.2
3321	-10	0	-0.0172	0.0374	-0.1920	0.0043	-0.1882	-0.0496	2.6
3339	-10	6	-0.0180	0.0969	-0.1819	0.0048	-0.1857	-0.0527	3.7
3358	-10	9	-0.0181	0.1292	-0.1759	0.0057	-0.1824	-0.0667	4.5
3361	-10	12	-0.0175	0.1642	-0.1707	0.0071	-0.1789	-0.0890	5.6
3312	0	0	-0.0189	-0.0089	-0.1986	-0.0026	-0.0106	-0.0688	2.2
3336	0	6	-0.0173	0.0493	-0.1956	-0.0002	-0.0107	-0.0500	3.1
3355	0	9	-0.0179	0.0774	-0.1987	0.0017	-0.0084	-0.0595	3.6
3364	0	12	-0.0171	0.1063	-0.1988	0.0044	-0.0050	-0.0712	4.3
3315	10	0	-0.0232	-0.0525	-0.1885	-0.0095	0.1637	-0.0865	1.4
3342	10	6	-0.0192	0.0032	-0.1988	-0.0075	0.1601	-0.0468	2.2
3351	10	9	-0.0182	0.0278	-0.2030	-0.0039	0.1617	-0.0442	2.6
3367	10	12	-0.0171	0.0468	-0.2059	-0.0001	0.1639	-0.0449	2.8
3395	20	-6	-0.0219	-0.1040	-0.1700	-0.0203	0.3527	-0.0769	2.6
3318	20	0	-0.0221	-0.0756	-0.1795	-0.0182	0.3513	-0.0785	1.7
3345	20	6	-0.0215	-0.0327	-0.1972	-0.0155	0.3448	-0.0504	1.6
3348	20	9	-0.0208	-0.0105	-0.2031	-0.0122	0.3412	-0.0412	1.5
3371	20	12	-0.0207	0.0084	-0.2125	-0.0086	0.3345	-0.0326	1.3

TABLE 42

SUPPLEMENTAL NON-DIMENSIONAL BARE HULL RESULTS, L/R = 0.412, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg	Cv
SPEED Cv = 0.48 to 1.7										
3429	0	-5	-0.0439	-0.0688	-1.5544	-0.0073	-0.0085	-0.2145	0.0	0.804
3434	0	-5	-0.0436	-0.0720	-1.0615	-0.0026	-0.0072	-0.2357	0.5	0.974
3430	0	-5	-0.0370	-0.0706	-0.7890	0.0003	-0.0049	-0.2293	1.3	1.130
3431	0	-5	-0.0285	-0.0682	-0.4647	-0.0019	-0.0047	-0.1862	1.9	1.474
3433	0	-5	-0.0286	-0.0784	-0.3101	-0.0018	-0.0071	-0.1785	1.3	1.804
3441	0	-6	-0.0066	-0.0567	-4.4470	-0.0349	0.0068	-0.1800	-0.2	0.476
3435	0	-6	-0.0404	-0.0824	-1.5356	-0.0086	-0.0067	-0.2429	0.0	0.809
3440	0	-6	-0.0433	-0.0883	-1.0578	-0.0035	-0.0064	-0.2739	0.4	0.975
3407	-10	-6	-0.0365	0.0660	-0.7715	0.0386	-0.1811	-0.2210	1.4	1.143
3405	0	-6	-0.0364	-0.0853	-0.7691	0.0017	-0.0041	-0.2608	1.4	1.145
3412	0	-6	-0.0379	-0.0862	-0.7734	0.0012	-0.0046	-0.2623	1.3	1.142
3437	0	-6	-0.0374	-0.0856	-0.7625	-0.0001	-0.0046	-0.2599	1.3	1.150
3409	10	-6	-0.0393	-0.2244	-0.7436	-0.0405	0.1716	-0.2713	1.3	1.143
3411	20	-6	-0.0426	-0.3172	-0.7056	-0.0748	0.3571	-0.2064	1.4	1.143
3384	0	-6	-0.0286	-0.0796	-0.5074	0.0001	-0.0037	-0.2169	1.9	1.410
3438	0	-6	-0.0294	-0.0834	-0.4638	-0.0020	-0.0044	-0.2113	1.9	1.475
3385	0	-6	-0.0284	-0.0930	-0.3644	-0.0008	-0.0054	-0.2110	1.5	1.664
3390	10	-6	-0.0304	-0.1547	-0.3289	-0.0184	0.1702	-0.2038	1.6	1.697
3394	20	-6	-0.0306	-0.1781	-0.3094	-0.0339	0.3558	-0.1464	1.9	1.695

TABLE 43.1

NON-DIMENSIONAL BARE HULL RESULTS, L/R = 0.206, AXES B
Displacement 155 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 12.5 knots, $C_v = 0.809$, Volume FN = 0.887									
2530	-10	-6	-0.0368	0.2612	-1.7446	0.0785	-0.1837	-0.1338	0.4
2462	-10	0	-0.0389	0.3060	-1.7154	0.0691	-0.1969	-0.0497	0.5
2480	-10	6	-0.0415	0.3425	-1.7164	0.0630	4.0394	0.0002	0.7
2483	-10	9	-0.0495	0.3701	-1.7333	0.0609	-0.1204	0.0254	0.7
2507	-10	12	-0.0530	0.4074	-1.7058	0.0622	-0.1519	0.0551	1.0
2527	0	-6	-0.0368	-0.0548	-1.7633	-0.0106	-0.0073	-0.1499	0.3
2459	0	0	-0.0417	0.0006	-1.7355	-0.0112	-0.0240	-0.0539	0.4
2477	0	6	-0.0425	0.0332	-1.7853	-0.0156	0.6464	0.0017	0.6
2486	0	9	-0.0495	0.0543	-1.7711	-0.0157	0.0557	0.0274	0.6
2504	0	12	-0.0546	0.0852	-1.7930	-0.0170	0.0278	0.0615	0.7
2524	10	-6	-0.0397	-0.3646	-1.7191	-0.1005	0.1676	-0.1455	0.3
2465	10	0	-0.0424	-0.3122	-1.7357	-0.0968	0.1524	-0.0550	0.4
2474	10	6	-0.0450	-0.2705	-1.7432	-0.0945	-0.4965	-0.0020	0.5
2490	10	9	-0.0496	-0.2510	-1.7540	-0.0947	0.2550	0.0207	0.5
2511	10	12	-0.0504	-0.2193	-1.7455	-0.0971	0.2058	0.0503	0.7
2521	20	-6	-0.0399	-0.6575	-1.6372	-0.1593	0.3549	-0.1400	0.3
2468	20	0	-0.0395	-0.6085	-1.6627	-0.1631	0.3452	-0.0608	0.4
2471	20	6	-0.0417	-0.5582	-1.6663	-0.1610	0.3029	-0.0177	0.6
2493	20	9	-0.0486	-0.5256	-1.6634	-0.1607	-0.0588	-0.0035	0.6
2514	20	12	-0.0504	-0.4991	-1.6882	-0.1581	0.4479	0.0177	0.7

TABLE 43.2

NON-DIMENSIONAL BARE HULL RESULTS, L/R = 0.206, AXES B
Displacement 155 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 35 knots, $C_v = 2.266$, Volume FN = 2.484									
2531	-10	-6	-0.0179	-0.0064	-0.2303	0.0018	-0.1909	-0.0390	3.0
2463	-10	0	-0.0191	0.0406	-0.2222	0.0058	-0.2070	-0.0221	2.7
2481	-10	6	-0.0198	0.0954	-0.2134	0.0072	-0.2090	-0.0188	3.5
2484	-10	9	-0.0200	0.1275	-0.2087	0.0084	-0.1939	-0.0296	4.3
2508	-10	12	-0.0192	0.1598	-0.2024	0.0103	-0.1841	-0.0430	5.4
2528	0	-6	-0.0223	-0.0593	-0.2273	-0.0051	-0.0122	-0.0731	2.5
2460	0	0	-0.0192	-0.0034	-0.2264	-0.0027	-0.0210	-0.0336	2.5
2478	0	6	-0.0180	0.0492	-0.2275	0.0010	-0.0223	-0.0239	3.3
2487	0	9	-0.0179	0.0764	-0.2288	0.0033	-0.0146	-0.0314	3.8
2505	0	12	-0.0175	0.1037	-0.2275	0.0061	-0.0086	-0.0402	4.5
2525	10	-6	-0.0261	-0.1082	-0.2105	-0.0120	0.1643	-0.0937	2.4
2466	10	0	-0.0232	-0.0475	-0.2221	-0.0113	0.1514	-0.0402	2.0
2475	10	6	-0.0190	0.0050	-0.2299	-0.0074	0.1481	-0.0239	2.7
2491	10	9	-0.0188	0.0306	-0.2346	-0.0042	0.1479	-0.0219	3.0
2512	10	12	-0.0162	0.0488	-0.2367	-0.0006	0.1638	-0.0313	3.6
2522	20	-6	-0.0256	-0.1363	-0.1903	-0.0202	0.3501	-0.0744	2.9
2469	20	0	-0.0230	-0.0827	-0.2106	-0.0203	0.3429	-0.0454	2.3
2519	20	0	-0.0230	-0.0834	-0.2104	-0.0197	0.3430	-0.0457	2.3
2472	20	6	-0.0209	-0.0312	-0.2279	-0.0163	0.3348	-0.0283	2.4
2517	20	6	-0.0215	-0.0331	-0.2290	-0.0159	0.3332	-0.0278	2.4
2494	20	9	-0.0196	-0.0046	-0.2377	-0.0129	0.3351	-0.0249	2.6
2515	20	12	-0.0173	0.0090	-0.2450	-0.0087	0.3410	-0.0243	2.8

TABLE 44.1

NON-DIMENSIONAL APPENDED HULL RESULTS, L/R = 0, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 12.5 knots, $C_v = 0.809$, Volume FN = 0.908									
1112	0	0	-0.0464	0.0000	-1.5295	-0.0001	0.3819	0.0052	0.0
1210	0	0	-0.0464	0.0000	-1.5295	-0.0037	0.3855	0.0051	0.0
1216	0	0	-0.0464	0.0000	-1.5295	-0.0027	0.3844	0.0051	0.0
1115	0	6	-0.0494	0.0424	-1.5296	-0.0035	0.0521	0.0413	0.0
1220	0	6	-0.0525	0.0455	-1.5296	-0.0046	0.0532	0.0439	0.0
1118	0	9	-0.0525	0.0728	-1.5296	-0.0040	0.0301	0.0775	0.0
1223	0	9	-0.0496	0.0730	-1.5357	-0.0072	0.0269	0.0803	0.0
1121	0	12	-0.0525	0.1091	-1.5296	-0.0023	0.0177	0.1318	0.0
1226	0	12	-0.0525	0.1031	-1.5296	-0.0068	0.0181	0.1291	0.0
1124	10	0	-0.0437	-0.2686	-1.5058	-0.0792	-1.9985	-0.0008	0.1
1229	10	0	-0.0439	-0.2667	-1.5124	-0.0822	1.1786	0.0017	0.1
1127	10	6	-0.0498	-0.2208	-1.5144	-0.0822	0.2462	0.0297	0.1
1232	10	6	-0.0470	-0.2217	-1.5204	-0.0849	0.2403	0.0298	0.1
1130	10	9	-0.0498	-0.1970	-1.5186	-0.0836	0.2108	0.0602	0.1
1235	10	9	-0.0468	-0.1970	-1.5185	-0.0857	0.2078	0.0602	0.1
1133	10	12	-0.0525	-0.1671	-1.5237	-0.0821	0.1983	0.1062	0.0
1238	10	12	-0.0525	-0.1671	-1.5237	-0.0850	0.1978	0.1087	0.0
1138	20	0	-0.0412	-0.5281	-1.4422	-0.1353	0.1944	-0.0087	0.2
1241	20	0	-0.0411	-0.5260	-1.4364	-0.1351	0.1280	-0.0062	0.2
1253	20	3	-0.0412	-0.5053	-1.4505	-0.1366	0.6107	0.0059	0.2
1141	20	6	-0.0471	-0.4776	-1.4541	-0.1359	0.5018	0.0132	0.2
1244	20	6	-0.0441	-0.4776	-1.4541	-0.1383	0.4886	0.0132	0.2
1144	20	9	-0.0471	-0.4520	-1.4635	-0.1374	0.4198	0.0326	0.2
1247	20	9	-0.0471	-0.4520	-1.4635	-0.1397	0.4160	0.0350	0.2
1147	20	12	-0.0504	-0.4252	-1.4798	-0.1394	0.3940	0.0668	0.2
1250	20	12	-0.0473	-0.4252	-1.4798	-0.1426	0.3903	0.0692	0.2

TABLE 44.2

NON-DIMENSIONAL APPENDED HULL RESULTS, L/R = 0, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 35 knots, $C_v = 2.266$, Volume FN = 2.541									
1113	0	0	-0.0218	0.0019	-0.1965	-0.0001	0.4204	0.0023	1.7
1217	0	0	-0.0218	0.0012	-0.1960	-0.0005	0.4190	0.0023	1.8
1218	0	0	-0.0218	0.0012	-0.1963	-0.0004	0.4185	0.0023	1.8
1116	0	6	-0.0225	0.0516	-0.1972	0.0034	-0.1646	-0.0056	2.4
1221	0	6	-0.0225	0.0542	-0.1966	0.0040	-0.1275	-0.0072	2.4
1119	0	9	-0.0234	0.0813	-0.1962	0.0068	-0.0489	-0.0186	2.9
1224	0	9	-0.0231	0.0833	-0.1973	0.0078	-0.0470	-0.0190	2.9
1122	0	12	-0.0245	0.1124	-0.1978	0.0116	-0.0303	-0.0298	3.5
1227	0	12	-0.0241	0.1126	-0.1974	0.0128	-0.0292	-0.0300	3.5
1125	10	0	-0.0222	-0.0368	-0.1929	-0.0091	0.0254	-0.0064	1.9
1136	10	0	-0.0223	-0.0372	-0.1931	-0.0089	0.0252	-0.0064	1.9
1230	10	0	-0.0222	-0.0360	-0.1930	-0.0091	0.0175	-0.0061	1.9
1128	10	6	-0.0210	0.0150	-0.2025	-0.0039	0.1150	-0.0136	2.4
1135	10	6	-0.0210	0.0151	-0.2028	-0.0039	0.1150	-0.0136	2.4
1233	10	6	-0.0214	0.0174	-0.2032	-0.0032	0.1174	-0.0145	2.4
1131	10	9	-0.0204	0.0374	-0.2065	0.0002	0.1514	-0.0290	3.0
1236	10	9	-0.0200	0.0394	-0.2068	0.0012	0.1524	-0.0293	3.0
1134	10	12	-0.0212	0.0564	-0.2097	0.0041	0.1552	-0.0353	3.2
1239	10	12	-0.0213	0.0589	-0.2111	0.0055	0.1553	-0.0357	3.2
1139	20	0	-0.0231	-0.0719	-0.1829	-0.0163	0.2143	-0.0067	2.1
1242	20	0	-0.0235	-0.0707	-0.1831	-0.0160	0.2031	-0.0063	2.1
1254	20	3	-0.0221	-0.0444	-0.1933	-0.0144	0.2880	-0.0120	2.3
1142	20	6	-0.0215	-0.0150	-0.2045	-0.0110	0.3279	-0.0229	2.7
1245	20	6	-0.0210	-0.0135	-0.2042	-0.0101	0.3293	-0.0230	2.7
1145	20	9	-0.0178	0.0061	-0.2117	-0.0069	0.3490	-0.0364	3.2
1248	20	9	-0.0178	0.0087	-0.2132	-0.0056	0.3491	-0.0367	3.2
1148	20	12	-0.0174	0.0200	-0.2172	-0.0039	0.3501	-0.0385	3.1
1214	20	12	-0.0177	0.0232	-0.2178	-0.0023	0.3497	-0.0389	3.1
1251	20	12	-0.0178	0.0236	-0.2183	-0.0022	0.3499	-0.0396	3.1

TABLE 45.1

NON-DIMENSIONAL APPENDED HULL RESULTS, L/R = 0.206, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 12.5 knots, $C_v = 0.809$, Volume FN = 0.908									
2278	-10	-6	-0.0345	0.2269	-1.5132	0.0701	-0.1854	-0.1183	0.2
2276	-10	-3	-0.0364	0.2677	-1.5187	0.0670	-0.1940	-0.0609	0.3
2217	-10	0	-0.0346	0.2708	-1.4994	0.0629	-0.1904	-0.0628	0.4
2242	-10	6	-0.0380	0.3134	-1.4985	0.0557	-0.2029	-0.0332	0.6
2252	-10	9	-0.0454	0.3370	-1.4945	0.0509	-0.2592	-0.0159	0.6
2272	-10	12	-0.0531	0.3725	-1.4886	0.0464	0.0862	0.0064	0.7
2281	0	-6	-0.0402	-0.0484	-1.5296	-0.0108	-0.0111	-0.1365	0.1
2214	0	0	-0.0346	0.0030	-1.5420	-0.0168	-0.0149	-0.0655	0.3
2246	0	6	-0.0371	0.0393	-1.5237	-0.0210	-0.0260	-0.0397	0.4
2249	0	9	-0.0448	0.0662	-1.5240	-0.0227	-0.0813	-0.0171	0.5
2268	0	12	-0.0461	0.0869	-1.5240	-0.0239	2.4288	0.0006	0.5
2284	10	-6	-0.0432	-0.3133	-1.4980	-0.0915	0.1643	-0.1403	0.1
2229	10	0	-0.0408	-0.2589	-1.5203	-0.1067	0.1568	-0.0684	0.3
2239	10	6	-0.0376	-0.2180	-1.5151	-0.0976	0.1526	-0.0406	0.5
2243	10	6	-0.0382	-0.2211	-1.5335	0.0249	0.1469	-0.0332	0.5
2255	10	9	-0.0416	-0.1956	-1.5068	-0.0973	0.1290	-0.0254	0.5
2265	10	12	-0.0435	-0.1747	-1.5292	-0.0999	-0.2379	-0.0031	0.5
2287	20	-6	-0.0402	-0.5686	-1.4208	-0.1490	0.3523	-0.1295	0.1
2233	20	0	-0.0374	-0.5202	-1.4386	-0.1502	0.3481	-0.0723	0.3
2236	20	6	-0.0375	-0.4701	-1.4506	-0.1533	0.3434	-0.0466	0.5
2258	20	9	-0.0423	-0.4440	-1.4668	-0.1565	0.3356	-0.0402	0.6
2262	20	12	-0.0433	-0.4186	-1.4759	-0.1564	0.3138	-0.0258	0.5

TABLE 45.2

NON-DIMENSIONAL APPENDED HULL RESULTS, L/R = 0.206, AXES B
Displacement 135 long tons

Run No.	Roll deg	Yaw deg	X'	Y'	Z'	K'	M'	N'	Trim deg
SPEED = 35 knots, $C_v = 2.266$, Volume FN = 2.541									
2279	-10	-6	-0.0189	-0.0082	-0.2019	0.0036	-0.1998	-0.0293	2.6
2277	-10	-3	-0.0202	0.0332	-0.1948	0.0039	-0.2026	-0.0304	2.3
2218	-10	0	-0.0188	0.0401	-0.1938	0.0035	-0.1998	-0.0306	2.3
2253	-10	9	-0.0276	0.1215	-0.1795	0.0029	-0.2315	-0.0219	2.5
2273	-10	12	-0.0279	0.1611	-0.1737	0.0038	-0.2101	-0.0330	3.4
2282	0	-6	-0.0222	-0.0530	-0.1960	-0.0034	-0.0159	-0.0575	2.3
2215	0	0	-0.0184	0.0011	-0.1980	-0.0048	-0.0173	-0.0409	2.2
2247	0	6	-0.0201	0.0541	-0.1966	-0.0047	-0.0147	-0.0483	3.0
2250	0	9	-0.0220	0.0692	-0.1960	-0.0022	-0.0346	-0.0248	2.7
2269	0	12	-0.0314	0.1069	-0.1977	-0.0011	0.1654	0.0093	1.6
2285	10	-6	-0.0260	-0.0953	-0.1829	-0.0095	0.1607	-0.0747	2.1
2230	10	0	-0.0204	-0.0382	-0.1953	-0.0135	0.1596	-0.0499	2.1
2240	10	6	-0.0189	0.0169	-0.2027	-0.0117	0.1633	-0.0507	2.8
2244	10	6	-0.0218	0.0271	-0.2056	-0.0033	0.1569	-0.0414	3.0
2256	10	9	-0.0222	0.0262	-0.2041	-0.0088	0.1331	-0.0222	2.0
2266	10	12	-0.0210	0.0475	-0.2076	-0.0063	0.1438	-0.0260	2.3
2289	20	-6	-0.0264	-0.1198	-0.1657	-0.0158	0.3484	-0.0765	2.1
2234	20	0	-0.0218	-0.0696	-0.1846	-0.0203	0.3434	-0.0446	2.1
2237	20	6	-0.0207	-0.0180	-0.2032	-0.0202	0.3461	-0.0459	2.4
2260	20	9	-0.0225	-0.0060	-0.2067	-0.0162	0.3285	-0.0285	1.7
2263	20	12	-0.0227	0.0144	-0.2145	-0.0141	0.3015	-0.0169	1.4

TABLE 46

NON-DIMENSIONAL RUDDER EFFECTIVENESS RESULTS, L/R = 0, AXES A & B
 Displacement 135 long tons
 Roll = Yaw = 0 deg

Run No.	Rudder δ deg	X'	Y'	Z'	K'	M'	N'	Trim deg
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AXES A

SPEED = 12.5 knots, $C_v = 0.809$, Volume FN = 0.908

1210	0	-0.0667	0.0000	-1.5288	-0.0036	0.0020	0.0052	0.0
1265	5	-0.0697	0.0121	-1.5288	-0.0042	0.0022	-0.0155	0.0
1261	10	-0.0697	0.0182	-1.5288	-0.0051	0.0022	-0.0259	0.0
1256	15	-0.0730	0.0213	-1.5349	-0.0060	0.0031	-0.0338	-0.3

SPEED = 35 knots, $C_v = 2.266$, Volume FN = 2.541

1217	0	-0.0305	0.0012	-0.1948	-0.0004	0.0010	0.0023	1.8
1264	5	-0.0313	0.0077	-0.1948	-0.0028	0.0010	-0.0125	1.8
1260	10	-0.0321	0.0108	-0.1951	-0.0036	0.0011	-0.0179	1.8
1262	10	-0.0322	0.0109	-0.1957	-0.0036	0.0011	-0.0179	1.8
1257	15	-0.0368	0.0147	-0.1951	-0.0043	0.0019	-0.0264	0.0
1258	15	-0.0364	0.0147	-0.1951	-0.0043	0.0019	-0.0261	0.0

AXES B

SPEED = 12.5 knots, $C_v = 0.809$, Volume FN = 0.908

1210	0	-0.0464	0.0000	-1.5295	-0.0037	0.3855	0.0051	0.0
1265	5	-0.0494	0.0121	-1.5296	-0.0040	-0.1382	-0.0156	0.0
1261	10	-0.0494	0.0182	-1.5296	-0.0048	-0.0830	-0.0259	0.0
1256	15	-0.0607	0.0213	-1.5355	-0.0057	-0.0921	-0.0338	-0.3

SPEED = 35 knots, $C_v = 2.266$, Volume FN = 2.541

1217	0	-0.0218	0.0012	-0.1960	-0.0005	0.4190	0.0023	1.8
1264	5	-0.0226	0.0077	-0.1960	-0.0023	-0.0793	-0.0127	1.8
1260	10	-0.0234	0.0108	-0.1963	-0.0028	-0.0584	-0.0180	1.8
1262	10	-0.0234	0.0109	-0.1969	-0.0028	-0.0584	-0.0180	1.8
1257	15	-0.0342	0.0147	-0.1956	-0.0040	-0.0723	-0.0265	0.0
1258	15	-0.0338	0.0147	-0.1956	-0.0040	-0.0724	-0.0261	0.0

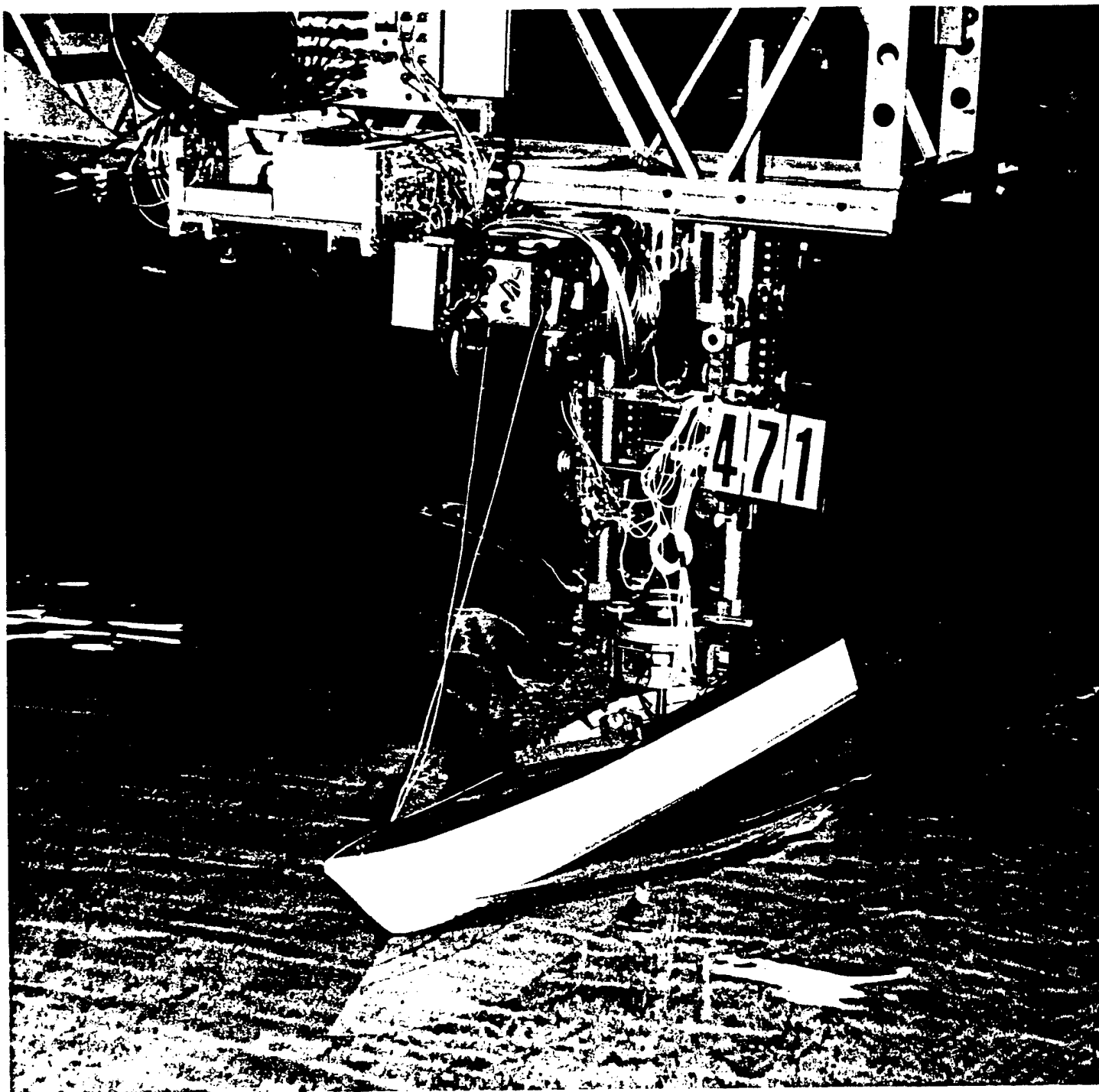


FIGURE 1 120 FT WPB, 155 I-TONS 20 DEG. ROLL, 6 DEG. YAW, SPEED 12.5 KNOTS
TURNING DIAMETER 9.7 BOAT LENGTHS

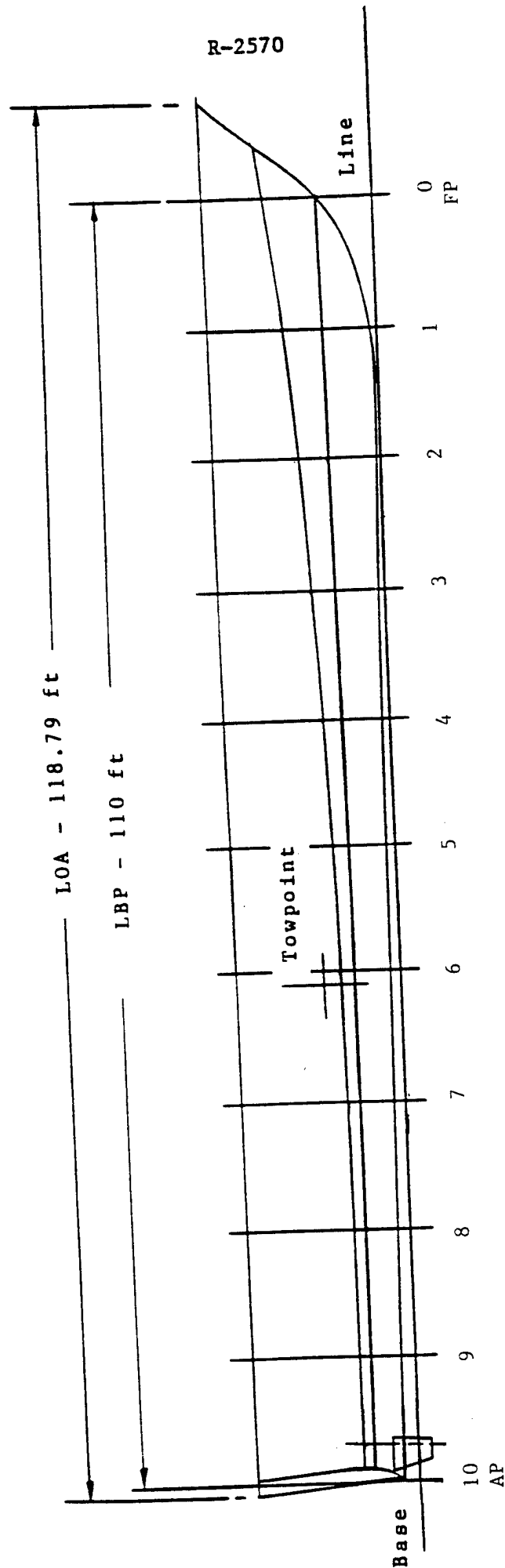


FIGURE 2 120 FT WPB PROFILE

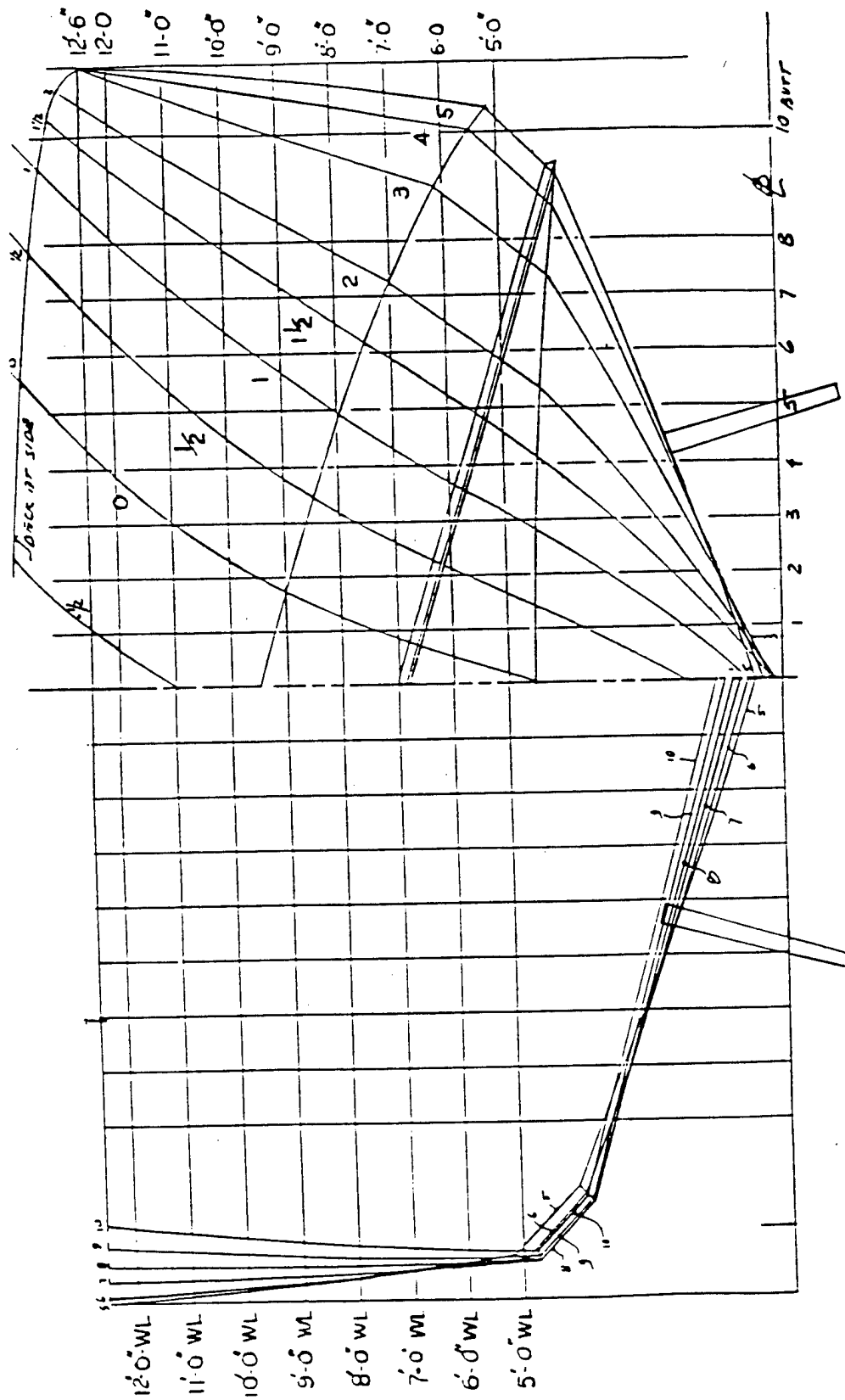


FIGURE 3 120 FT WPB BODY LINES

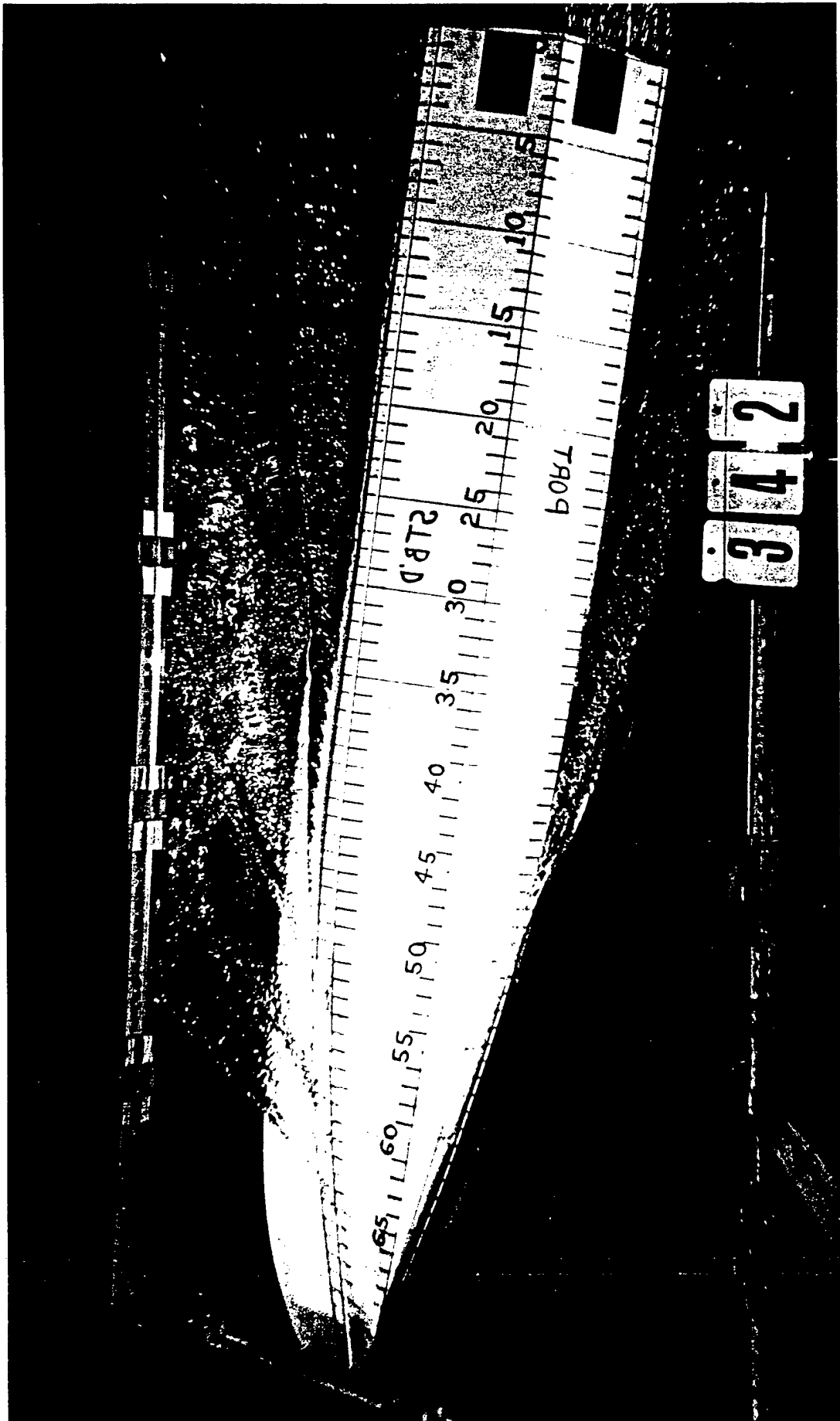


FIGURE 4

120 FT WPB, 135 L-TONS 10 DEG ROLL,
6 DEG YAW, SPEED 35 KNOTS
TURNING DIAMETER 9.7 BOAT LENGTHS

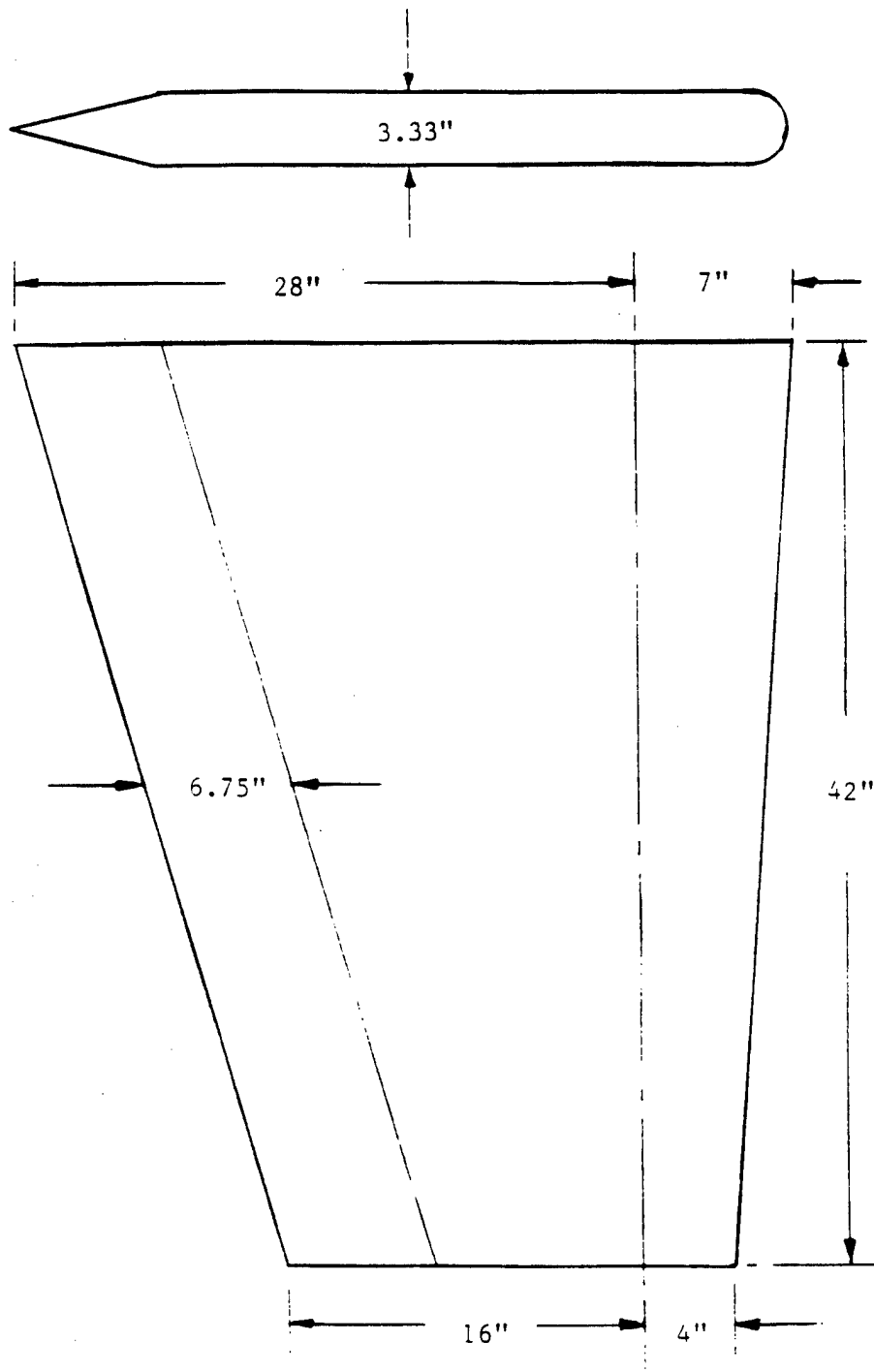


FIGURE 5 RUDDER DRAWING

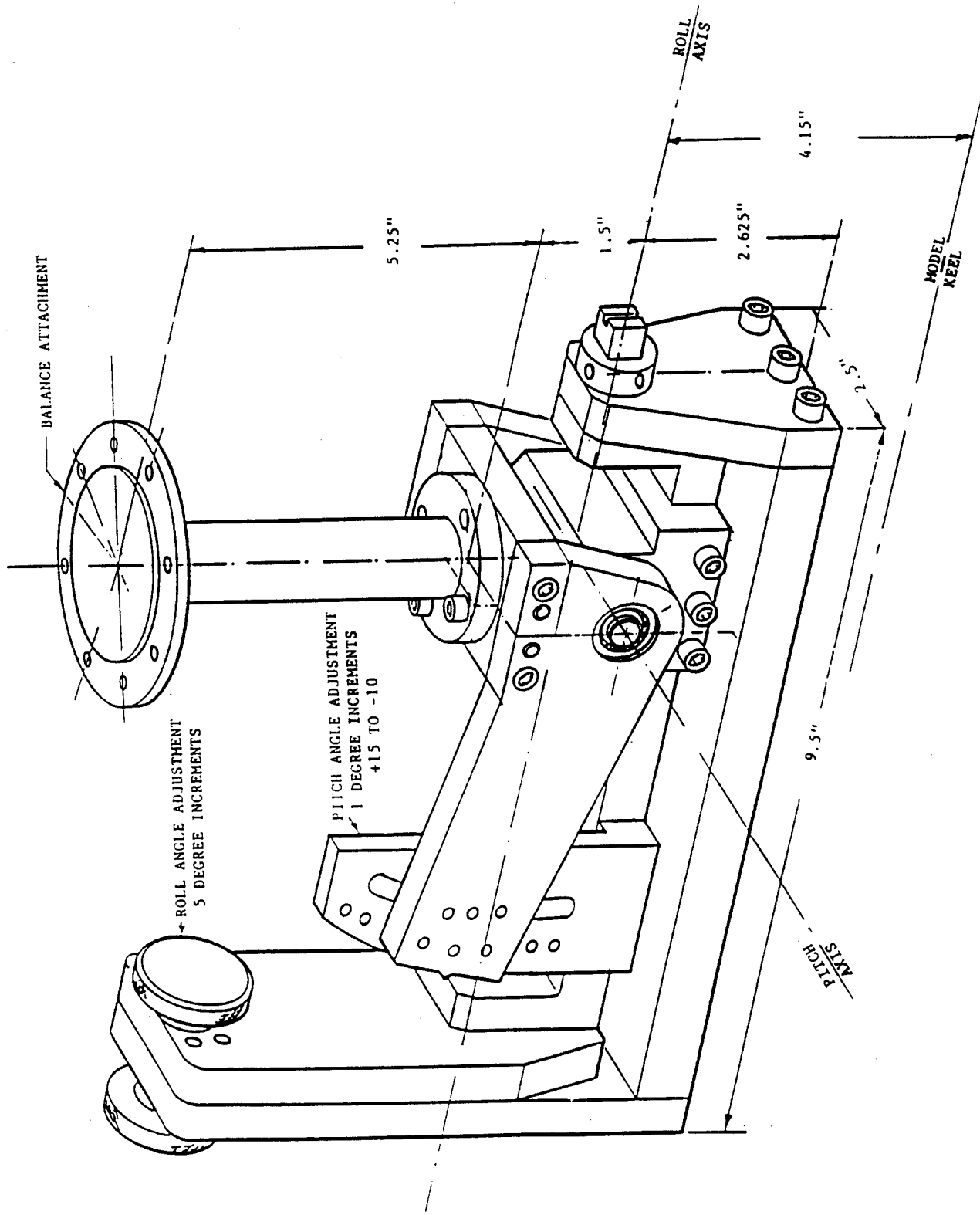


FIGURE 6 PITCH AND ROLL PIVOT BOX

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APPENDIX A

CHRONOLOGICAL LISTING OF STRAIGHT COURSE RUNS

Note: The data acquisition program used during these tests automatically assigned a sequential three digit number to each test point, including calibrations and check runs, from 001 to 999. A prefix of "1" was added to the Straight Course Tests, so that their Run Numbers run from 1001 to 1330.

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Appended hull with rudders at 0° Displacement 135 long tons				
1001 - 1110	Calibration and check runs			
1111	0.0	0	0	0.00
1112	12.5	0	0	4.98
1113	35.0	0	0	13.93
1114	0.0	0	6	0.00
1115	12.5	0	6	4.98
1116	35.0	0	6	13.92
1117	0.0	0	9	0.00
1118	12.5	0	9	4.98
1119	35.1	0	9	13.97
1120	0.0	0	12	0.00
1121	12.5	0	12	4.98
1122	35.0	0	12	13.93
1123	0.0	10	0	0.00
1124	12.5	10	0	4.98
1125	35.1	10	0	13.94
1126	0.0	10	6	0.00
1127	12.5	10	6	4.98
1128	35.0	10	6	13.93
1129	0.0	10	9	0.00
1130	12.5	10	9	4.98
1131	35.1	10	9	13.94
1132	0.0	10	12	0.00
1133	12.5	10	12	4.98
1134	35.1	10	12	13.95
1135	35.0	10	6	13.92
1136	35.0	10	0	13.93
1137	0.0	20	0	0.00
1138	12.5	20	0	4.97
1139	35.1	20	0	13.94

APPENDIX A

CHRONOLOGICAL LISTING OF STRAIGHT COURSE RUNS

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Appended hull with rudders at 0° Displacement 135 long tons				
1140	0.0	20	6	0.00
1141	12.5	20	6	4.98
1142	35.0	20	6	13.92
1143	0.0	20	9	0.00
1144	12.5	20	9	4.98
1145	35.1	20	9	13.94
1146	0.0	20	12	0.00
1147	12.5	20	12	4.97
1148	35.0	20	12	13.92
1148 - 1208	Re-calibrated using more sensitive settings			
1209	0.0	0	0	0.00
1210	12.5	0	0	4.98
1211	NG	0	0	0.00
1212	NG	0	0	
1213	NG	0	0	
1214	NG	0	0	13.94
1215	0.0	0	0	0.00
1216	12.5	0	0	4.98
1217	35.1	0	0	13.95
1218	35.1	0	0	13.94
1219	0.0	0	6	0.00
1220	12.5	0	6	4.98
1221	35.1	0	6	13.94
1222	0.0	0	9	0.00
1223	12.5	0	9	4.97
1224	35.0	0	9	13.93
1225	0.0	0	12	0.00
1226	12.5	0	12	4.98
1227	35.1	0	12	13.94
1228	0.0	10	0	0.00
1229	12.5	10	0	4.97
1230	35.1	10	0	13.94
1231	0.0	10	6	0.00
1232	12.5	10	6	4.97
1233	35.0	10	6	13.92

APPENDIX A

CHRONOLOGICAL LISTING OF STRAIGHT COURSE RUNS

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Appended hull with rudders at 0° Displacement 135 long tons				
1234	0.0	10	9	0.00
1235	12.5	10	9	4.98
1236	35.1	10	9	13.94
1237	0.0	10	12	0.00
1238	12.5	10	12	4.98
1239	35.0	10	12	13.92
1240	0.0	20	0	0.00
1241	12.5	20	0	4.98
1242	35.1	20	0	13.95
1243	0.0	20	6	0.00
1244	12.5	20	6	4.98
1245	35.1	20	6	13.95
1246	0.0	20	9	0.00
1247	12.5	20	9	4.98
1248	35.0	20	9	13.92
1249	0.0	20	12	0.00
1250	12.5	20	12	4.97
1251	35.0	20	12	13.93
1252	0.0	20	3	0.00
1253	12.5	20	3	4.97
1254	35.0	20	3	13.93

RUDDER TESTS

Rudder deflection, deg

1255	0.0	15	0	0	0.00
1256	12.5	15	0	0	4.97
1257	35.1	15	0	0	13.94
1258	35.1	15	0	0	13.94
1259	0.0	10	0	0	0.00
1260	35.1	10	0	0	13.94
1261	12.5	10	0	0	4.98
1262	35.0	10	0	0	13.92
1263	0.0	5	0	0	0.00
1264	35.1	5	0	0	13.95
1265	12.5	5	0	0	4.98

APPENDIX A

CHRONOLOGICAL LISTING OF STRAIGHT COURSE RUNS

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Bare hull Displacement 135 long tons				
1266 - 1271	Calibration check runs			
1272	0.0	0	0	0.00
1273	12.5	0	0	4.97
1274	35.0	0	0	13.93
1275	0.0	0	6	0.00
1276	12.5	0	6	4.98
1277	35.1	0	6	13.95
1278	0.0	0	9	0.00
1279	12.5	0	9	4.98
1280	35.0	0	9	13.93
1281	0.0	0	12	0.00
1282	12.5	0	12	4.97
1283	12.5	0	12	4.98
1284	35.1	0	12	13.94
1285	0.0	10	0	0.00
1286	12.5	10	0	4.98
1287	35.0	10	0	13.93
1288	35.0	10	0	13.92
1289	0.0	10	6	0.00
1290	12.5	10	6	4.97
1291	35.0	10	6	13.93
1292	0.0	10	9	0.00
1293	12.5	10	9	4.98
1294	35.0	10	9	13.92
1295	0.0	10	12	0.00
1296	12.5	10	12	4.98
1297	35.1	10	12	13.95
1298	0.0	20	0	0.00
1299	12.5	20	0	4.98
1300	35.0	20	0	13.93
1301	0.0	20	6	0.00
1302	12.5	20	6	4.98
1303 - 1304	Calibration check runs			
1305	35.0	20	6	13.93

APPENDIX A

CHRONOLOGICAL LISTING OF STRAIGHT COURSE RUNS

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Bare hull Displacement 135 long tons				
1306	0.0	20	9	0.00
1307	12.5	20	9	4.97
1308	35.1	20	9	13.94
1309	0.0	20	12	0.00
1310	12.5	20	12	4.97
1311	35.0	20	12	13.93
1312	0.0	20	3	0.00
1313	35.0	20	3	13.90
1314	0.0	0	12	0.00
1315	35.0	0	12	13.92
1316	0.0	0	11	0.00
1317	35.0	0	11	13.92
1318	0.0	0	3	0.00
1319	35.0	0	3	13.93
1320	0.0	10	3	0.00
1321	35.1	10	3	13.95
1322	0.0	-10	-6	0.00
1323	12.5	-10	-6	4.97
1324	35.0	-10	-6	13.93
1325	0.0	-20	-6	0.00
1326	12.5	-20	-6	4.98
1327	35.1	-20	-6	13.94
1328	0.0	0	-6	0.00
1329	12.5	0	-6	4.98
1330	35.1	0	-6	13.95

END OF STRAIGHT COURSE TESTS

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APPENDIX B

CHRONOLOGICAL LISTING OF ROTATING ARM RUNS

Note: The data acquisition program used during these tests automatically assigned a sequential three digit number to each test point, including calibrations and check runs, from 001 to 999. The run sequence was restarted at the beginning of the Rotating Arm Tests and a prefix of "2" was added to the Tests at 32 ft Radius, and a prefix of "3" to the Tests at 16 ft Radius, so that their Run Numbers run from 2001 to 2289, from 3290 to 3441, and from 2442 to 2542

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Bare hull				
L/R = 0.206 (32 ft radius)				
Displacement 135 long tons				
2001 - 2111	Calibration and check runs			
2112 - 2120	Air tares, bare hull			
2121 - 2132	Calibration check runs			
2133	0.0	0	0	0.00
2134	12.6	0	0	5.00
2135	0.0	0	0	0.00
2136	35.0	0	0	13.93
2137	0.0	-10	0	0.00
2138	12.5	-10	0	4.98
2139	35.3	-10	0	14.02
2140	0.0	10	0	0.00
2141	12.5	10	0	4.99
2142	35.1	10	0	13.94
2143	0.0	20	0	0.00
2144	12.5	20	0	4.98
2145	35.1	20	0	13.96
2146	0.0	0	6	0.00
2147	0.0	0	6	0.00
2148 - 2149	NG	0	6	
2150	12.4	0	6	4.95
2151	12.5	0	6	4.96
2152	34.8	0	6	13.84
2153	0.0	-10	6	0.00
2154	12.5	-10	6	4.97
2155	34.8	-10	6	13.84

APPENDIX B

CHRONOLOGICAL LISTING OF ROTATING ARM RUNS

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Bare hull L/R = 0.206 (32 ft radius) Displacement 135 long tons				
2156	0.0	10	6	0.00
2157	12.5	10	6	4.98
2158	34.9	10	6	13.88
2159	Calibration check			
2160	0.0	20	6	0.00
2161	12.5	20	6	4.98
2162	35.0	20	6	13.91
2163 - 2172	Calibration check runs			
2173	12.4	0	9	4.93
2174	34.9	0	9	13.87
2175	0.0	-10	9	0.00
2176	12.5	-10	9	4.99
2177	35.0	-10	9	13.90
2178	0.0	10	9	0.00
2179	12.5	10	9	4.98
2180	35.1	10	9	13.94
2181	0.0	20	9	0.00
2182	12.5	20	9	4.97
2183	34.9	20	9	13.88
2184	0.0	20	12	0.00
2186	12.5	20	12	4.99
2187	35.1	20	12	13.94
2188	0.0	10	12	0.00
2189	12.5	10	12	4.98
2190	35.0	10	12	13.90
2191	35.0	10	12	13.92
2192	0.0	0	12	0.00
2193	12.5	0	12	4.97
2194	35.0	0	12	13.90
2195	0.0	-10	12	0.00
2196	12.5	-10	12	4.98
2197	35.0	-10	12	13.91

APPENDIX B

CHRONOLOGICAL LISTING OF ROTATING ARM RUNS

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Bare hull L/R = 0.206 (32 ft radius) Displacement 135 long tons				
2198	0.0	-10	-6	0.00
2199	35.1	-10	-6	13.94
2200	NG			
2201	12.5	-10	-6	4.98
2202	0.0	0	-6	0.00
2203	12.5	0	-6	4.96
2204	34.9	0	-6	13.86
2205	0.0	10	-6	0.00
2206	12.5	10	-6	4.98
2207	NG, Overload in Y			
2208	0.0	20	-6	0.00
2209	12.5	20	-6	4.98
2210	0.0	20	-6	0.00
2211	35.1	20	-6	13.95
2212	35.1	10	-6	13.94
Appended hull with rudders at 0° L/R = 0.206 (32 ft radius) Displacement 135 long tons				
2213	0.0	0	0	0.00
2214	12.5	0	0	4.96
2215	34.9	0	0	13.88
2216	0.0	-10	0	0.00
2217	12.5	-10	0	4.99
2218	34.9	-10	0	13.89
2218 - 2227	Calibration check runs			
2228	0.0	10	0	0.00
2229	12.5	10	0	4.96
2230	34.8	10	0	13.85
2231	NG	20	0	
2232	0.0	20	0	0.00
2233	12.5	20	0	4.98
2234	35.0	20	0	13.91
2235	0.0	20	6	0.00
2236	12.5	20	6	4.99
2237	35.0	20	6	13.92

APPENDIX B

CHRONOLOGICAL LISTING OF ROTATING ARM RUNS

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Appended hull with rudders at 0°				
L/R = 0.206 (32 ft radius)				
Displacement 135 long tons				
2238	0.0	10	6	0.00
2239	12.5	10	6	4.98
2240	35.1	10	6	13.94
2241	0.0	-1	6	0.00
2242	12.5	-1	6	4.98
2243	12.4	10	6	4.95
2244	35.0	10	6	13.91
2245	0.0	0	6	0.00
2246	12.5	0	6	4.99
2247	35.1	0	6	13.95
2248	0.0	0	9	0.00
2249	12.5	0	9	4.99
2250	35.1	0	9	13.97
2251	0.0	-10	9	0.00
2252	12.5	-10	9	4.98
2253	35.0	-10	9	13.91
2254	0.0	10	9	0.00
2255	12.6	10	9	5.00
2256	35.1	10	9	13.94
2257	0.0	20	9	0.00
2258	12.5	20	9	4.98
2259	NG	20	9	
2260	35.1	20	9	13.94
2261	0.0	20	12	0.00
2262	12.5	20	12	4.98
2263	35.0	20	12	13.92
2264	0.0	10	12	0.00
2265	12.5	10	12	4.97
2266	35.1	10	12	13.95
2267	0.0	0	12	0.00
2268	12.5	0	12	4.99
2269	35.0	0	12	13.90
2270	NG	-10	12	
2271	NG	-10	12	
2272	12.5	-10	12	4.98
2273	34.9	-10	12	13.89

APPENDIX B

CHRONOLOGICAL LISTING OF ROTATING ARM RUNS

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Appended hull with rudders at 0°				
L/R = 0.206 (32 ft radius)				
Displacement 135 long tons				
2274	0.0	-10	-6	0.00
2275	NG	-10	-6	
2276	12.5	-10	-3	4.96
2277	35.0	-10	-3	13.90
2278	12.5	-10	-6	4.98
2279	35.0	-10	-6	13.91
2280	0.0	0	-6	0.00
2281	12.5	0	-6	4.98
2282	35.1	0	-6	13.96
2283	0.0	10	-6	0.00
2284	12.5	10	-6	4.98
2285	35.1	10	-6	13.94
2286	0.0	20	-6	0.00
2287	12.5	20	-6	4.98
2288	NG	20	-6	
2289	35.1	20	-6	13.94

Bare hull
L/R = 0.412 (16 ft radius)
Displacement 135 long tons

3290 - 3299 Calibration check runs

3300 - 3309 Air tares, bare hull

3310	0.0	0	0	0.00
3311	12.5	0	0	4.97
3312	34.9	0	0	13.86
3313	0.0	10	0	0.00
3314	12.5	10	0	4.97
3315	35.2	10	0	13.99
3316	0.0	20	0	0.00
3317	12.5	20	0	4.98
3318	35.2	20	0	14.00
3319	0.0	-10	0	0.00
3320	12.5	-10	0	4.98
3321	35.1	-10	0	13.97

APPENDIX B

CHRONOLOGICAL LISTING OF ROTATING ARM RUNS

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Bare hull				
L/R = 0.412 (16 ft radius)				
Displacement 135 long tons				
3322	0.0	-10	-6	0.00
3323	12.5	-10	-6	4.98
3324	NG, Overload in Y and N		-10	-6
3325 - 3333	Calibration check runs			
3334	0.0	0	6	0.00
3335	12.5	0	6	4.99
3336	35.2	0	6	13.98
3337	0.0	-10	6	0.00
3338	12.5	-10	6	4.98
3339	35.2	-10	6	13.98
3340	0.0	10	6	0.00
3341	12.5	10	6	4.98
3342	35.2	10	6	13.98
3343	0.0	20	6	0.00
3344	12.5	20	6	4.99
3345	35.0	20	6	13.93
3346	0.0	20	9	0.00
3347	12.5	20	9	4.97
3348	35.2	20	9	14.00
3349	0.0	10	9	0.00
3350	12.5	10	9	4.99
3351	35.2	10	9	13.99
3352	0.0	0	9	0.00
3353	NG	0	9	
3354	12.5	0	9	4.99
3355	34.9	0	9	13.88
3356	0.0	-10	9	0.00
3357	12.5	-10	9	4.98
3358	35.2	-10	9	14.01
3359	0.0	-10	12	0.00
3360	12.6	-10	12	5.00
3361	35.2	-10	12	14.00
3362	12.5	0	12	4.99
3363	0.0	0	12	0.00
3364	34.9	0	12	13.89

APPENDIX B

CHRONOLOGICAL LISTING OF ROTATING ARM RUNS

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Bare hull				
L/R = 0.412 (16 ft radius)				
Displacement 135 long tons				
3365	0.0	10	12	0.00
3366	12.5	10	12	4.98
3367	35.2	10	12	14.01
3368	0.0	20	12	0.00
3369	12.5	20	12	4.97
3370	NG	20	12	
3371	35.0	20	12	13.91
3372	NG	-10	-6	
3373	0.0	-10	-6	0.00
3374	NG, Overload in K	-10	-6	
3375	35.2	-10	-6	14.00
3376 - 3379	Calibration check runs			
3380	0.0	0	-6	0.00
3381	12.5	0	-6	4.97
3382	12.4	0	-6	4.94
3383	NG	0	-6	
3384	21.8	0	-6	8.66
3385	25.7	0	-6	10.22
3386	NG	0	-6	
3387	0.0	10	-6	0.00
3388	12.6	10	-6	5.00
3389	NG	10	-6	
3390	26.2	10	-6	10.42
3391	0.0	20	-6	0.00
3392	NG	20	-6	
3393	12.5	20	-6	4.98
3394	26.2	20	-6	10.41
3395	35.2	20	-6	13.99
3396 - 3402	Calibration checks runs			
3403	0.0	0	-6	0.00
3405	NG	0	-6	
3406	0.0	-10	-6	0.00
3407	17.7	-10	-6	7.02
3408	0.0	10	-6	0.00
3409	17.7	10	-6	7.02

APPENDIX B

CHRONOLOGICAL LISTING OF ROTATING ARM RUNS

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Bare hull				
L/R = 0.412 (16 ft radius)				
Displacement 135 long tons				
3410	0.0	20	-6	0.00
3411	17.7	20	-6	7.02
3412	17.6	0	-6	7.01
3413 - 3427	Calibration checks runs			
3428	0.0	0	-5	0.00
3429	12.4	0	-5	4.94
3430	17.5	0	-5	6.94
3431	22.8	0	-5	9.05
3433	27.9	0	-5	11.08
3434	15.0	0	-5	5.98
3435	12.5	0	-6	4.97
3436	0.0	0	-6	0.00
3437	17.8	0	-6	7.06
3438	22.8	0	-6	9.06
3439	NG	0	-6	
3440	15.1	0	-6	5.99
3441	7.3	0	-6	2.92
Bare hull				
L/R = 0.206 (32 ft radius)				
Displacement 155 long tons				
2442	0.0	0	-6	0.00
2443 - 2457	Calibration check runs			
2458	0.0	0	0	0.00
2459	12.6	0	0	5.01
2460	35.0	0	0	13.91
2461	0.0	-10	0	0.00
2462	12.6	-10	0	5.00
2463	35.0	-10	0	13.93
2464	0.0	10	0	0.00
2465	12.5	10	0	4.97
2466	34.9	10	0	13.89
2467	0.0	20	0	0.00
2468	12.5	20	0	4.96
2469	35.0	20	0	13.92

APPENDIX B

CHRONOLOGICAL LISTING OF ROTATING ARM RUNS

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Bare hull L/R = 0.206 (32 ft radius) Displacement 155 long tons				
2470	0.0	20	6	0.00
2471	12.5	20	6	4.98
2472	35.1	20	6	13.96
2473	0.0	10	6	0.00
2474	12.5	10	6	4.97
2475	35.1	10	6	13.94
2476	0.0	0	6	0.00
2477	12.4	0	6	4.94
2478	34.9	0	6	13.89
2479	0.0	-10	6	0.00
2480	12.5	-10	6	4.99
2481	35.0	-10	6	13.92
2482	0.0	-10	9	0.00
2483	12.5	-10	9	4.96
2484	35.0	-10	9	13.91
2485	0.0	0	9	0.00
2486	12.5	0	9	4.96
2487	34.9	0	9	13.86
2488	0.0	10	9	0.00
2489	0.0	10	9	0.00
2490	12.5	10	9	4.96
2491	35.1	10	9	13.94
2492	0.0	20	9	0.00
2493	12.6	20	9	5.00
2494	35.1	20	9	13.96
2495 - 2502	Calibration check runs			
2503	0.0	0	12	0.00
2504	12.4	0	12	4.93
2505	35.0	0	12	13.91
2506	0.0	-10	12	0.00
2507	12.5	-10	12	4.99
2508	35.1	-10	12	13.95

APPENDIX B

CHRONOLOGICAL LISTING OF ROTATING ARM RUNS

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Bare hull				
L/R = 0.206 (32 ft radius)				
Displacement 155 long tons				
2509	NG	10	12	0.00
2510	0.0	10	12	0.00
2511	12.5	10	12	4.98
2512	35.2	10	12	13.98
2513	0.0	20	12	0.00
2514	12.5	20	12	4.98
2515	34.9	20	12	13.89
2516	0.0	20	6	0.00
2517	35.0	20	6	13.91
2518	0.0	20	0	0.00
2519	35.0	20	0	13.92
2520	0.0	20	-6	0.00
2521	12.5	20	-6	4.97
2522	35.1	20	-6	13.96
2523	0.0	10	-6	0.00
2524	12.5	10	-6	4.98
2525	35.0	10	-6	13.93
2526	0.0	0	-6	0.00
2527	12.5	0	-6	4.97
2528	34.9	0	-6	13.89
2529	0.0	-10	-6	0.00
2530	12.5	-10	-6	4.97
2531	35.1	-10	-6	13.94
2532	0.0	0	0	0.00
2533	0.0	5	0	0.00
2534	0.0	10	0	0.00
2535	0.0	16	0	0.00
2536	0.0	20	0	0.00
2537	0.0	21	0	0.00
2538	0.0	-5	0	0.00
2539	0.0	-10	0	0.00
2540	0.0	-16	0	0.00
2541	0.0	-20	0	0.00
2542	0.0	-3	0	0.00

APPENDIX B

CHRONOLOGICAL LISTING OF ROTATING ARM RUNS

Run Number	Boat Speed knots	Roll Angle deg	Yaw Angle deg	Model Speed fps
Bare hull				
L/R = 0.206 (32 ft radius)				
Displacement 135 long tons				
2543	0.0	0	0	0.00
2544	0.0	5	0	0.00
2545	0.0	10	0	0.00
2546	0.0	10	0	0.00
2547	0.0	16	0	0.00
2548	0.0	20	0	0.00
2549	0.0	21	0	0.00
2550	0.0	-3	0	0.00
2551	0.0	-5	0	0.00
2552	0.0	-11	0	0.00
2553	0.0	-16	0	0.00
2554	0.0	-21	0	0.00
2555	0.0	0	0	0.00
2556	35.1	0	-6	13.95
2557	35.1	0	0	13.95
2558	35.1	0	6	13.95
2559	35.1	0	12	13.95

END OF ROTATING ARM TESTS

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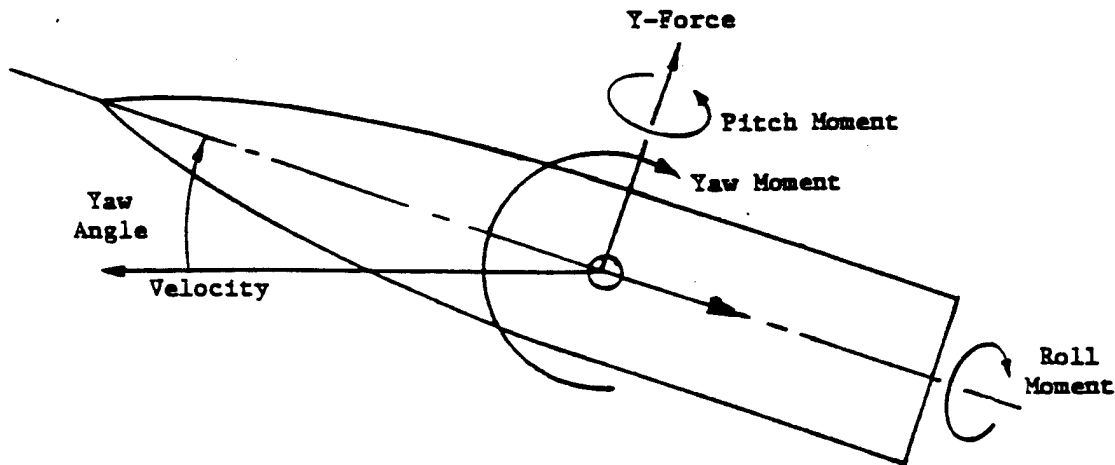
APPENDIX C

AXES SYSTEMS AND AIR TARES

Axes Coordinate Systems and Transformations

Measurement Axes Set

The model forces and moments were measured in balance axes with origin fixed in the model at a point 28.6 inches forward of the aft perpendicular and 5.875 inches above the baseline. The orthogonal balance axes system rotates with the model in yaw, and remains parallel to the water surface with the z-axis vertical. This system is illustrated in Sketch C1 where the positive sense of the forces and moments is indicated. The hydrodynamic forces and moments acting on the hull measured in balance axes are denoted by suffix "m". The vertical force, Z_m , is positive upward.



Sketch C1

Measurement Axes

- ϕ roll angle, positive starboard side down
- θ trim angle, positive bow up
- β yaw angle, positive bow to starboard
- X_m longitudinal force, positive toward the stern
- Y_m lateral force, positive to starboard
- Z_m vertical force, positive upward
- K_m roll moment, positive starboard side down
- M_m pitch moment, positive bow up
- N_m yaw moment, positive bow to starboard

Free-to-trim testing

In free-to-trim tests of planing boats it is customary to tow the model through its center of gravity so that the pitching moment about the towpoint is zero. In the present tests of the 120 ft WPB the model CG was below the towpoint or center of moments, CM, due to model ballasting constraints. The longitudinal position of both the CM and the CG was 26.6 inches forward of the AP, as noted in Table 1. However the height of the CM was 5.875 inches above the baseline whereas the height of the CG, for the 135 ℓ -ton condition, was only 5.35 inches. The CG was vertically below the CM when the baseline was horizontal and a small bow down moment developed when the model trimmed up from this position. Since the baseline has a positive inclination of 0.76 degrees relative to the afterbody keel, the trim is -0.76 degrees when the baseline is horizontal.

The magnitude of the applied moment about the model CM due to the CG offset is:

$$\Delta (VCG - VCM) \sin(\theta + 0.76) \cos \phi, \text{ lb-ft} \quad (C.1)$$

The model scale value of the leading multiplying constant in Equation C.1 is -2.206 at the 135 ℓ -ton condition, and -2.244 at the 155 ℓ -ton condition. The applied pitching moments calculated from Equation C.1 have been tabulated in the pitching moment columns in Tables 5 to 13.

It may be noted here that the model CG's at both displacements were slightly higher than the Design CG.

Body Coordinate System A

In order to describe the position of the hull on the surface of the water the US Coast Guard specifies a set of right-handed, orthogonal axes fixed in the body and moving with it. This system is referred to as System A and it is very similar to the measurement axes set. In System A, unlike the measurement set, the longitudinal force, X_A , is positive toward the bow, and the vertical force, Z_A , is positive downward. The lateral force, Y_A , is still positive to starboard.

In System A moments are positive in a clockwise sense looking in the positive direction of the axes. The same convention applies to angular displacements. The positive sense of the angular displacements and moments is the same in both System A and the measurement set. It may be noted that System A is a consistent right-handed orthogonal set of axes.

However the origins of the two systems do not coincide. The origin of System A is specified to be at the craft Design CG, which corresponds to a point in the model 28.6 inches forward of the AP and 5.047 inches above the baseline. The origin of the measurement system is at the test center of moments (CM), also 28.6 inches forward of the AP but 5.875 inches above the baseline. Therefore the conversion to System A involves a translation of the axes, which does not affect the magnitude of the forces but does affect the moments.

If the coordinates of the test center of moment, CM, in Axes System A are (x_A, y_A, z_A) , then the following equations are obtained for the forces and moments in the new translated System A:

$$\begin{aligned} x_A &= -x_m & K_A &= K_m + z_A y_m + y_A z_m \\ y_A &= +y_m & M_A &= M_m + z_A x_m - x_A z_m \\ z_A &= -z_m & N_A &= N_m - y_A x_m - x_A y_m \end{aligned} \quad (C.2)$$

When the model is at -0.76 degrees pitch and zero roll, the CG is vertically below the center of moments at a distance of ℓ ft. While Axes System A yaws with the model, it does not pitch or roll, therefore the following expressions are found for the coordinates of the CG:

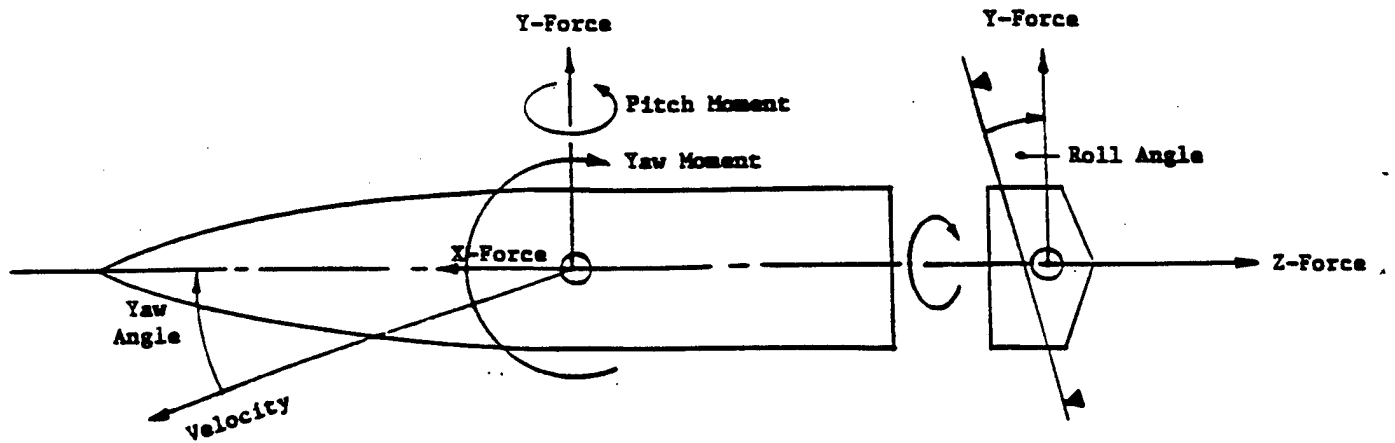
$$\begin{aligned} x_A &= \ell \cos \phi \sin (\theta + 0.76) \\ y_A &= -\ell \sin \phi \\ z_A &= \ell \cos \phi \cos (\theta + 0.76) \end{aligned} \quad (C.3)$$

In these tests the distance ℓ from the CM to the Design CG was 0.069 ft model scale. Equations C.2 and C.3 are used to convert the measured forces and moments into Body Coordinate System A with origin at the Design CG.

Body Coordinate System B

In order to describe the position of the hull on the surface of the water the US Coast Guard specifies a second set of right-handed, orthogonal axes fixed in the body and moving with it. The origin of this system is fixed at the Design CG. Therefore the origins of System A and System B coincide.

Coordinate System B is a right-handed body axes system, with the xz plane fixed in the plane of symmetry of the model, whose axes rotate with the model in yaw, roll and pitch. In System B the x axis is parallel to the baseline. When the model is at zero roll and -0.76 degrees pitch System B coincides with System A. Sketch C2 indicates the positive sense of the forces and moments in System B:



Sketch C2

Forces and moments in System B are obtained from those in System A by the following transformations:

$$\begin{aligned}
 X_B &= X_A \cos (\theta + 0.76) - Z_A \sin (\theta + 0.76) \\
 Y_B &= X_A \sin \phi \sin (\theta + 0.76) + Y_A \cos \phi + Z_A \sin \phi \cos (\theta + 0.76) \\
 Z_B &= X_A \cos \phi \sin (\theta + 0.76) - Y_A \sin \phi + Z_A \cos \phi \cos (\theta + 0.76) \\
 K_B &= K_A \cos (\theta + 0.76) - N_A \sin (\theta + 0.76) \\
 M_B &= K_A \sin \phi \sin (\theta + 0.76) + M_A \cos \phi + N_A \sin \phi \cos (\theta + 0.76) \\
 N_B &= K_A \cos \phi \sin (\theta + 0.76) - M_A \sin \phi + N_A \cos \phi \cos (\theta + 0.76)
 \end{aligned} \tag{C.4}$$

Normalization

The forces and moments are reported in dimensional form, model scale, and in non-dimensional form. The following non-dimensionalizing scheme is used:

Dimensional Quantity	Non-Dimensional Form
Force, F lb	F/qb^2
Moment, M lb-ft	M/qb^3
Velocity, V fps	V/\sqrt{gb}
Rate of turn, Ω radians/second	$\Omega/(V/L) = \Omega/(\Omega R/L) = L/R$

where q = dynamic pressure, $\frac{1}{2} \rho V^2$, psf
 b = maximum beam at chine, ft
 V = velocity of pivot point, fps
 g = acceleration due to gravity, fps^2
 R = radius of turn, ft
 L = boat length overall, ft

Air Tares

When a model is tested on the rotating arm it experiences both inertia forces, due to angular acceleration, and hydrodynamic forces. The inertia forces are measured by running the model in air above the water surface. The resulting forces are largely due to centrifugal acceleration and are spoken of as air tares. The measured air tares are given in Table C.

The longitudinal and lateral forces (X and Y shown in Sketch C1) are resolved into a Side-force, acting at right angles to the velocity vector and positive to starboard, and a Drag acting parallel and opposite to the velocity vector:

$$\text{Side-force} = Y \cos \beta - X \sin \beta \quad (\text{C.5})$$

$$\text{Drag} = Y \sin \beta + X \cos \beta \quad (\text{C.6})$$

Expressions for the Side-force and Drag air tares (SF_a and D_a) were found from an analysis of the test data:

$$SF_a = -1.427 V^2/R \quad (\text{C.7})$$

$$D_a = 0.00135 V^2 \quad (\text{C.8})$$

where V = velocity, fps
 R = radius of turn, ft

The longitudinal and lateral air tares (X_a and Y_a) in measurement axes are found from the side-force and drag:

$$X_a = D_a \cos \beta - SF_a \sin \beta \quad (\text{C.9})$$

$$Y_a = D_a \sin \beta + SF_a \cos \beta \quad (\text{C.10})$$

Roll moments and yaw moments were also found from the air tare data:

$$K_a = 0.089 Y_a \quad (\text{C.11})$$

$$N_a = 0.018 Y_a \quad (\text{C.12})$$

The air tares calculated from Equations C.7 to C.12 were subtracted from the measured air tares given in Table C as a check on the analysis, and the resulting small residuals are shown in the lower half of Table C.

TABLE C

AIR TARE TEST RESULTS

Run	Roll deg	Trim deg	Yaw deg	Speed fps	X lb	Y lb	K lb-ft	N lb-ft
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Rate of turn, L/R = 0.412 Radius of turn = 16 ft (model)

306	0	0	-6	4.89	-0.3	-2.2	-0.19	-0.1
300	0	0	0	4.91	0.0	-2.1	-0.18	-0.1
303	0	0	12	4.91	0.5	-2.1	-0.17	0.0
307	0	0	-6	8.81	-0.6	-6.9	-0.62	-0.2
301	0	0	0	8.76	0.1	-6.9	-0.62	-0.2
304	0	0	12	8.76	1.6	-6.6	-0.57	0.0
308	0	0	-6	13.93	-1.6	-17.4	-1.58	-0.5
302	0	0	0	13.93	0.3	-17.3	-1.51	-0.3
305	0	0	12	13.97	3.9	-16.7	-1.38	0.0
309	20	0	-6	13.99	-1.7	-17.4	-1.66	-0.5

Rate of turn, L/R = 0.206 Radius of turn = 32 ft (model)

115	0	0	-6	4.93	-0.1	-1.1	-0.08	0.0
114	0	0	0	4.94	0.0	-1.1	-0.09	0.0
120	0	0	12	4.95	0.3	-1.0	-0.10	0.0
116	0	0	-6	8.89	-0.3	-3.5	-0.30	-0.1
113	0	0	0	8.88	0.1	-3.5	-0.29	0.0
119	0	0	12	8.85	0.8	-3.3	-0.28	0.0
117	0	0	-6	13.96	-0.7	-8.7	-0.80	-0.3
112	0	0	0	13.94	0.2	-8.6	-0.75	-0.1
118	0	0	12	13.90	2.0	-8.3	-0.73	0.1

RESIDUALS = MEASURED AIR TARES - CURVE FIT VALUES

Rate of turn, L/R = 0.412 Radius of turn = 16 ft (model)

306	0	0	-6	4.89	-0.1	-0.1	-0.00	-0.1
300	0	0	0	4.91	-0.0	0.0	0.01	-0.1
303	0	0	12	4.91	0.0	-0.0	0.02	0.0
307	0	0	-6	8.81	0.0	-0.0	-0.01	-0.1
301	0	0	0	8.76	-0.0	-0.1	-0.01	-0.1
304	0	0	12	8.76	0.1	0.1	0.02	0.1
308	0	0	-6	13.93	-0.1	-0.2	-0.05	-0.2
302	0	0	0	13.93	0.0	0.0	0.03	0.0
305	0	0	12	13.97	0.0	0.3	0.13	0.3
309	20	0	-6	13.99	-0.1	-0.0	-0.12	-0.2

Rate of turn, L/R = 0.206 Radius of turn = 32 ft (model)

115	0	0	-6	4.93	-0.0	-0.0	0.02	0.0
114	0	0	0	4.94	-0.0	-0.0	0.01	0.0
120	0	0	12	4.95	0.0	0.1	-0.01	0.0
116	0	0	-6	8.89	-0.0	0.0	0.01	-0.0
113	0	0	0	8.88	-0.0	0.0	0.02	0.1
119	0	0	12	8.85	-0.0	0.1	0.02	0.1
117	0	0	-6	13.96	-0.1	-0.0	-0.03	-0.1
112	0	0	0	13.94	-0.1	0.1	0.02	0.1
118	0	0	12	13.99	-0.0	0.1	0.01	0.3

APPENDIX D

GRAPHICAL PRESENTATION OF THE BARE HULL DATA

Presentation of the Data

The data is presented graphically in the following order: Longitudinal Force Coefficient, X' , Lateral Force Coefficient, Y' , Roll Moment Coefficient, K' , and Yaw Moment Coefficient, N' . X' , Y' and N' are a function of the Yaw Angle, Ψ , the Roll Angle, Φ , and the Dimensionless Angular Velocity, L/R . Since it is impossible to visualize a four dimensional space, the data is presented in a series of two dimensional plots. For example, X' is first plotted versus the Yaw Angle, Ψ , with the Roll Angle, Φ , as a parameter for three successive values of the Dimensionless Angular Velocity, L/R , then versus the Yaw Angle, Ψ , with the Dimensionless Angular Velocity, L/R as a parameter for four successive values of the Roll Angle, Φ , and finally versus the Dimensionless Angular Velocity, L/R with the Roll Angle, Φ , as a parameter for five successive values of the Yaw Angle, Ψ , for a speed of 12.5 Knots. It is felt that these plots furnish sufficient insight into the relationship between the dependent variable X' and the independent variables Ψ , Φ and L/R . The sequence of graphs is then repeated for a speed of 35 knots. The plots for Y' and N' follow this same sequence.

The Roll Moment Coefficient, K' , is a function of the Roll Angle, Φ , the Yaw Angle, Ψ , and the Dimensionless Angular Velocity, L/R . K' is first plotted versus the Roll Angle, Φ , with the Yaw Angle, Ψ , as a parameter for three successive values of the Dimensionless Angular Velocity, L/R , then versus the Roll Angle, Φ , with the Dimensionless Angular Velocity, L/R as a parameter for five successive values of the Yaw Angle, Ψ and finally versus the Dimensionless Angular Velocity, L/R , with the Yaw Angle, Ψ as a parameter for four successive values of the Roll Angle, Φ , at 12.5 knots. The sequence is then repeated for a speed of 35 knots.

Uniform scales are used on the force and moment axes, so that a direct comparison may be made between the values of X' and Y' , and K' and N' . Crosses are always used to represent the zero values of a parameter, and the line through these data points is always solid. Plus and minus values of a parameter are always denoted by empty and solid symbols. Thus if the Roll Angle, Φ , is a parameter, +10 degrees may be an empty square, and then -10 will be a solid square. This is done to permit the reader to spot functional symmetry, or the lack thereof.

Discussion of the Graphs

The Longitudinal Force Coefficient data are presented in Figures D-1 through D-24. The data for 12.5 knots varies from about -0.06 to -0.09. It exhibits a moderate dependence on the Yaw Angle, Ψ , a small dependence on the Roll Angle, Φ , and a moderate dependence on the Dimensionless Angular Velocity, L/R . The data for 35 knots varies from about -0.025 to -0.04. There is a small dependence on the Yaw Angle, Ψ , and the Dimensionless Angular Velocity, L/R , and a moderate dependence on the Roll Angle, Φ . The Longitudinal Force Coefficient has a smaller value at 35 knots than it does at 12.5 knots because the longitudinal force is divided by the square of the velocity when calculating the coefficient.

The Lateral Force Coefficient data are given in Figures D-25 through D-48. The data for 12.5 and 35 knots shows a strong, somewhat nonlinear, dependence on the Yaw Angle, Ψ , and a moderate dependence on Roll Angle, Φ , and Dimensionless Angular Velocity, L/R .

The Roll Moment Coefficient data are presented in Figures D-49 through D-72. The data for 12.5 knots display a strong dependence on the Roll Angle, Φ , and a small dependence on Yaw Angle, Ψ , and Dimensionless Angular Velocity, L/R . The plots of K' versus Roll Angle, Φ , differ from the normal righting arm curves that naval architects are used to seeing. The righting arm curve gives the roll moment required to produce a given roll angle, whereas these curves give the equal and opposite reaction to this moment. These curves represent the moment exerted by the water on the boat. The data for 35 knots exhibit small to moderate dependence on Roll Angle, Φ , Yaw Angle, Ψ , and Dimensionless Angular Velocity, L/R . This hull appears to have less transverse stability at 35 knots than it does at 12.5 knots.

The Lateral Moment Coefficient data are given in Figures D-73 through D-96. The data for 12.5 knots demonstrate a strong, nonlinear dependence on the Yaw Angle, Ψ , the Roll Angle Φ , and the Dimensionless Angular Velocity, L/R . The data for 35 knots shows a moderate, nonlinear dependence on the Yaw Angle, Ψ , the Roll Angle, Φ , and the Dimensionless Angular Velocity, L/R .

A more in depth analysis of the data, involving the use of symmetry arguments and mathematical curve fitting techniques would permit a more insightful discussion of the data, and the prediction of turning and maneuvering trajectories. However, this sort of analysis is beyond the scope of the work reported here.

Acknowledgment

Appendix D was prepared by personnel at the USCG Research and Development Center, Groton, CT. MS. Elizabeth Weaver prepared all of the graphs. Her work is particularly appreciated.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

L/R=0, Speed = 12.5 Knots

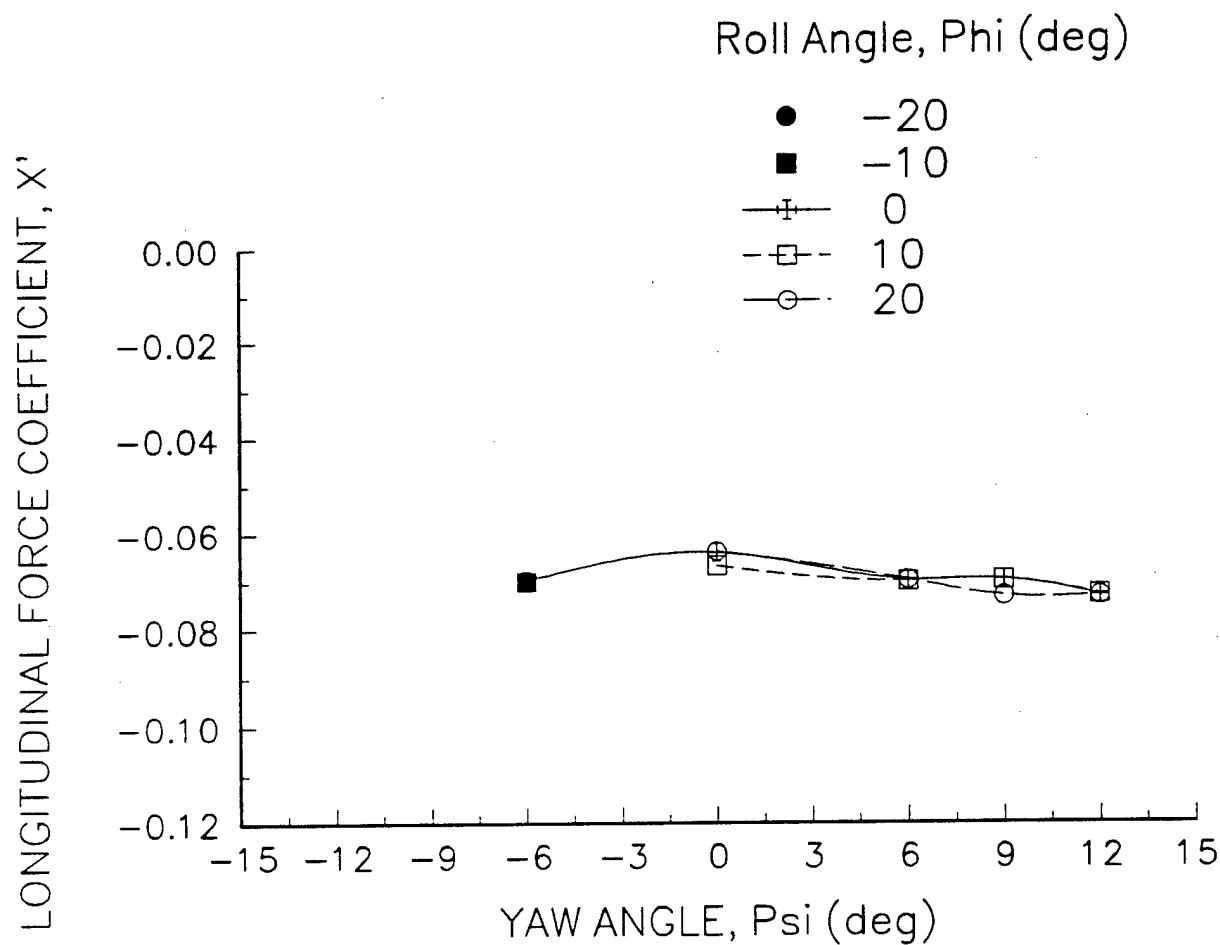


Figure D-1. X' versus Ψ with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.000 and a speed of 12.5 knots.

120 FT. NOTIONAL WPB DESIGN

Displacement 135 LTons

L/R=.206, Speed = 12.5 Knots

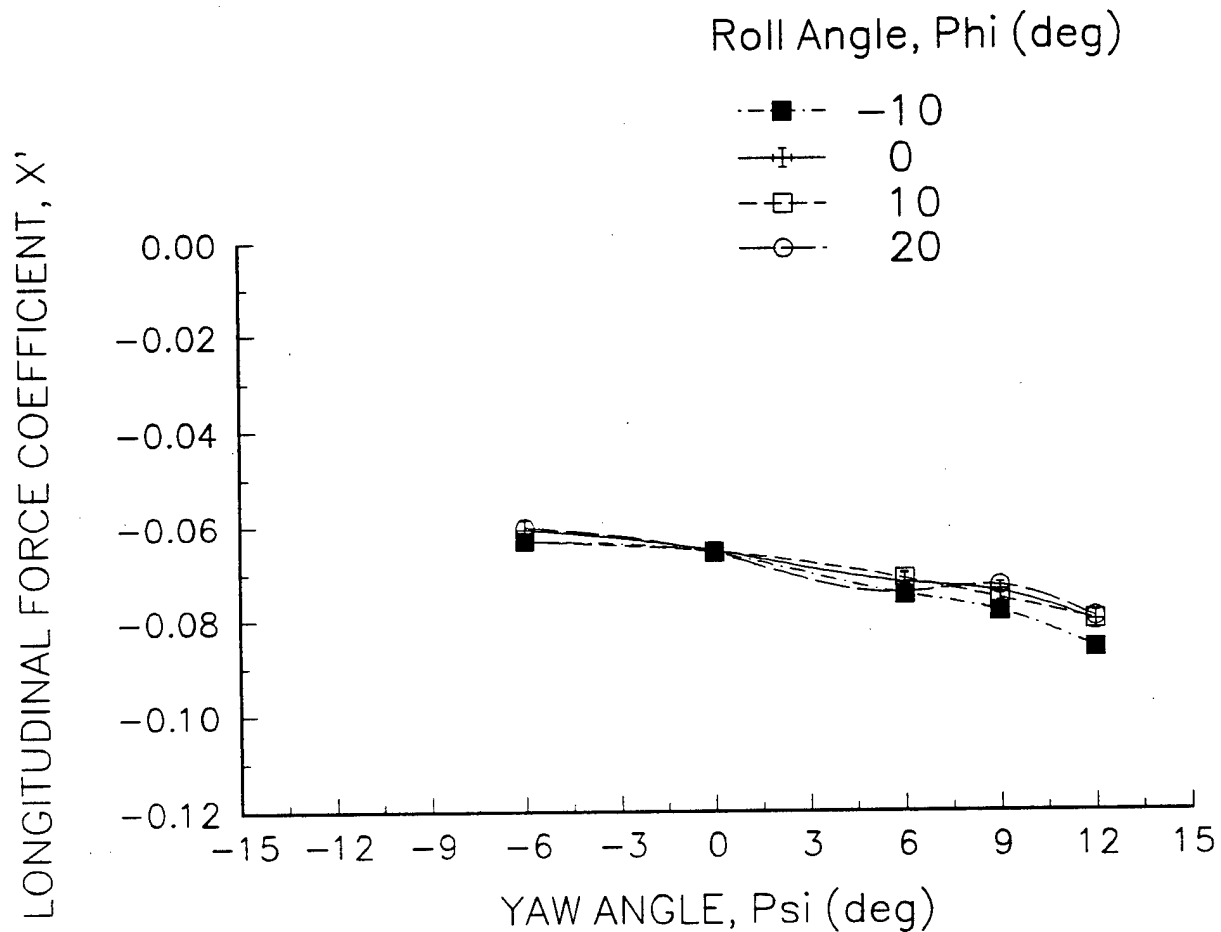


Figure D-2. X' versus Psi with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.206 and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

L/R=.412, Speed = 12.5.Knots

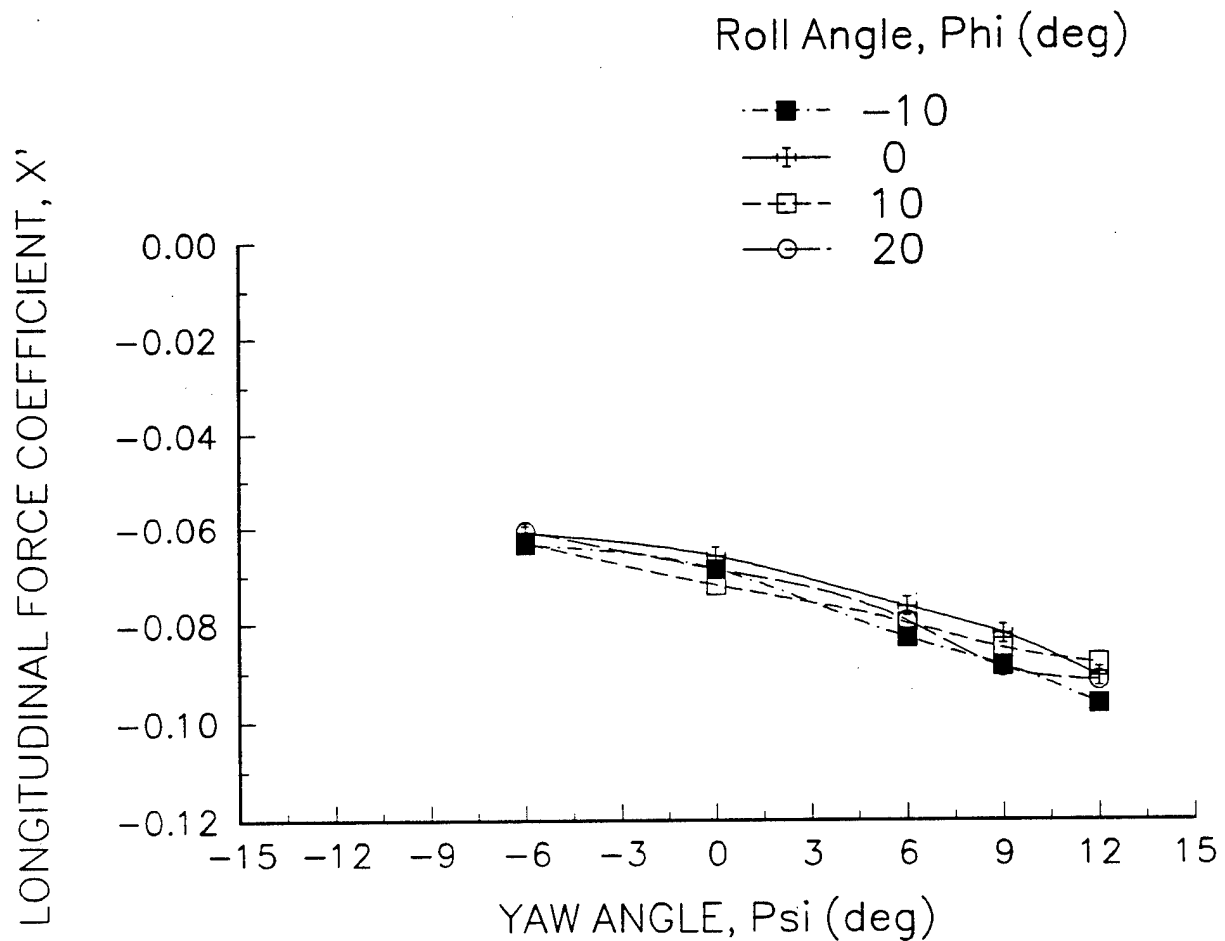


Figure D-3. X' versus Psi with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.412 and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN
 Displacement 135 LTons
 ROLL ANGLE, Φ (deg) = -10, Speed = 12.5 Knots

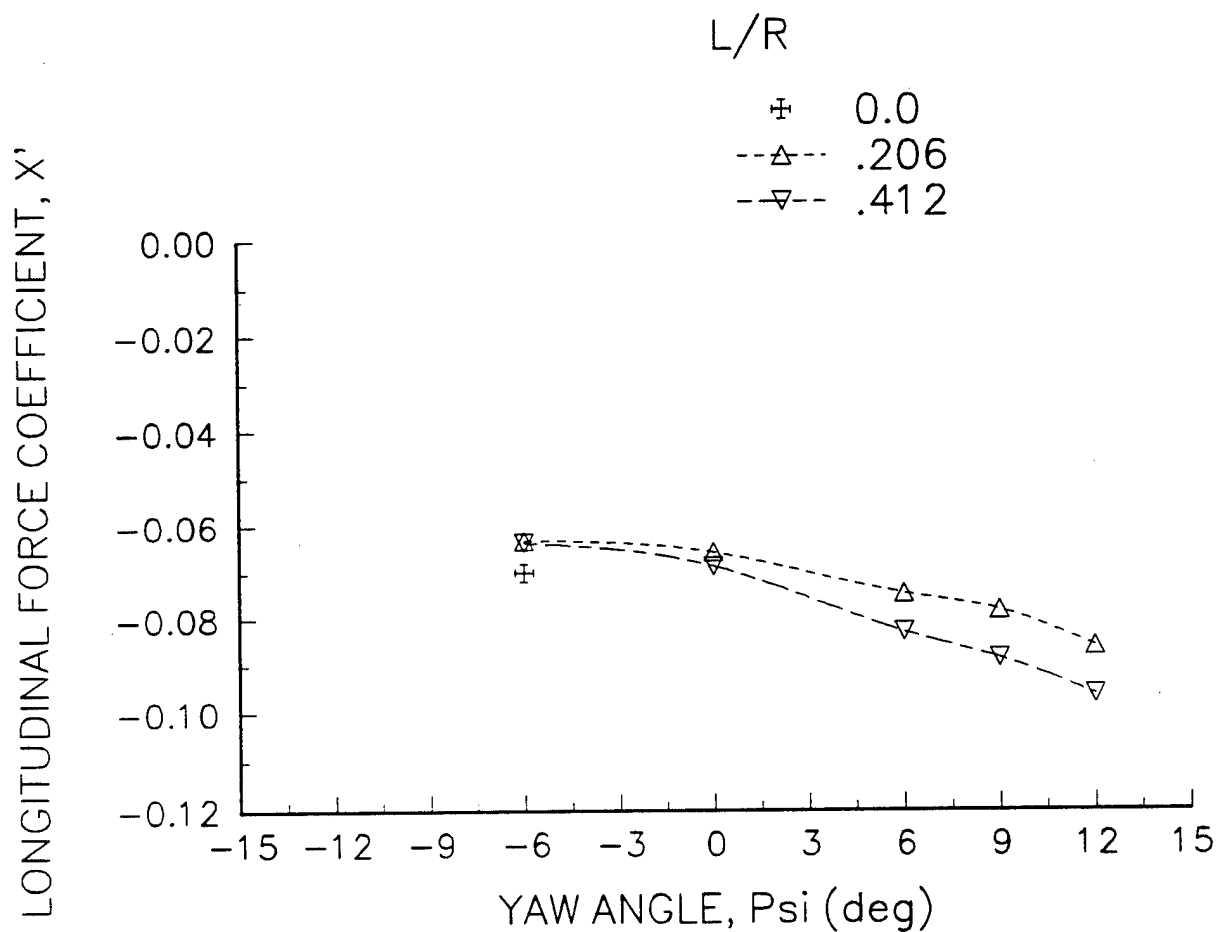


Figure D-4. X' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of -10 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN
 Displacement 135 LTons
 ROLL ANGLE, Φ (deg) = 0, Speed = 12.5 Knots

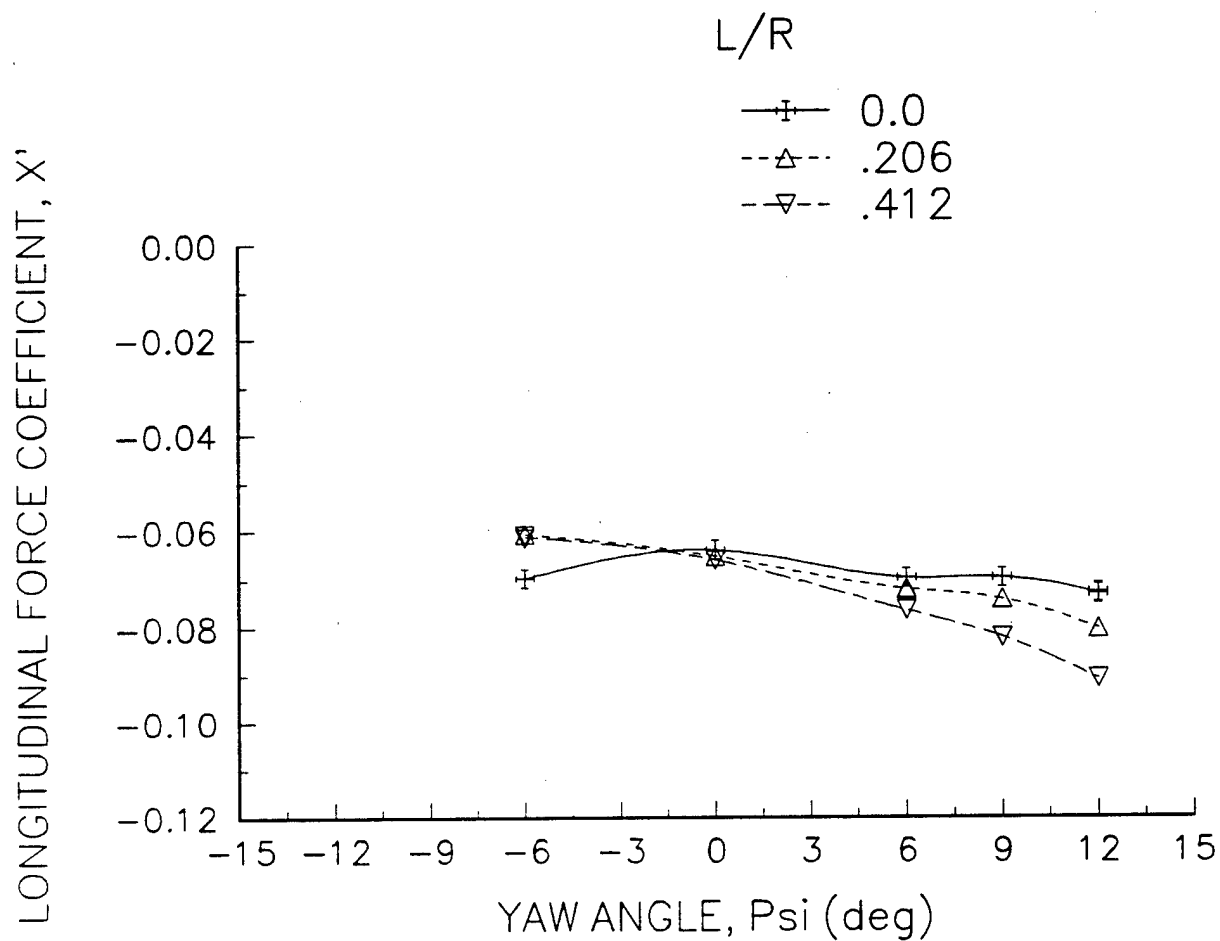


Figure D-5. X' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 0 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN
Displacement 135 LTons
ROLL ANGLE, Φ (deg) = 10, Speed = 12.5 Knots

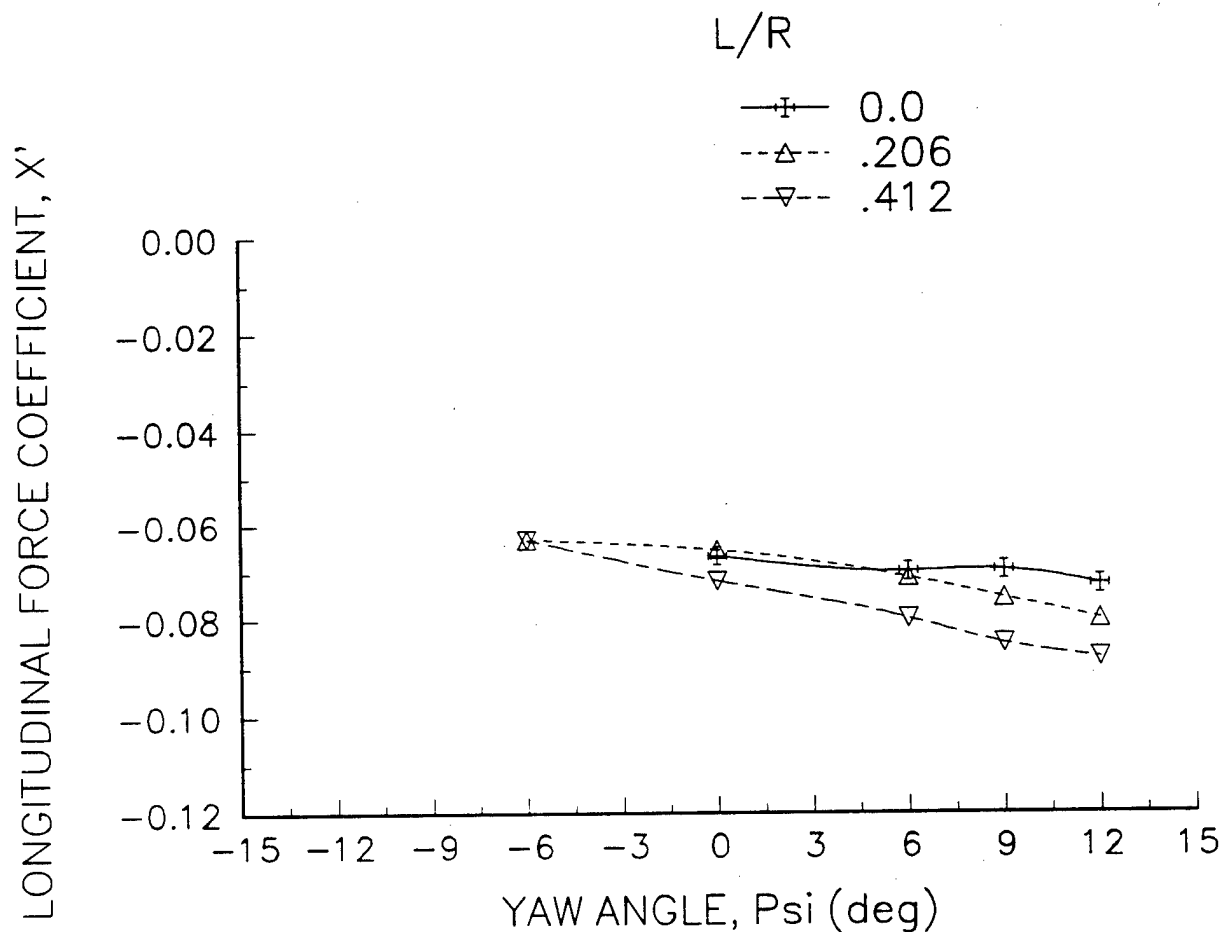


Figure D-6. X' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 10 degrees and a speed of 12.5 knots.

1 20 FT NOTIONAL WPB DESIGN

Displacement 1 35 LTons

ROLL ANGLE, Φ (deg) = 20, Speed = 12.5 Knots

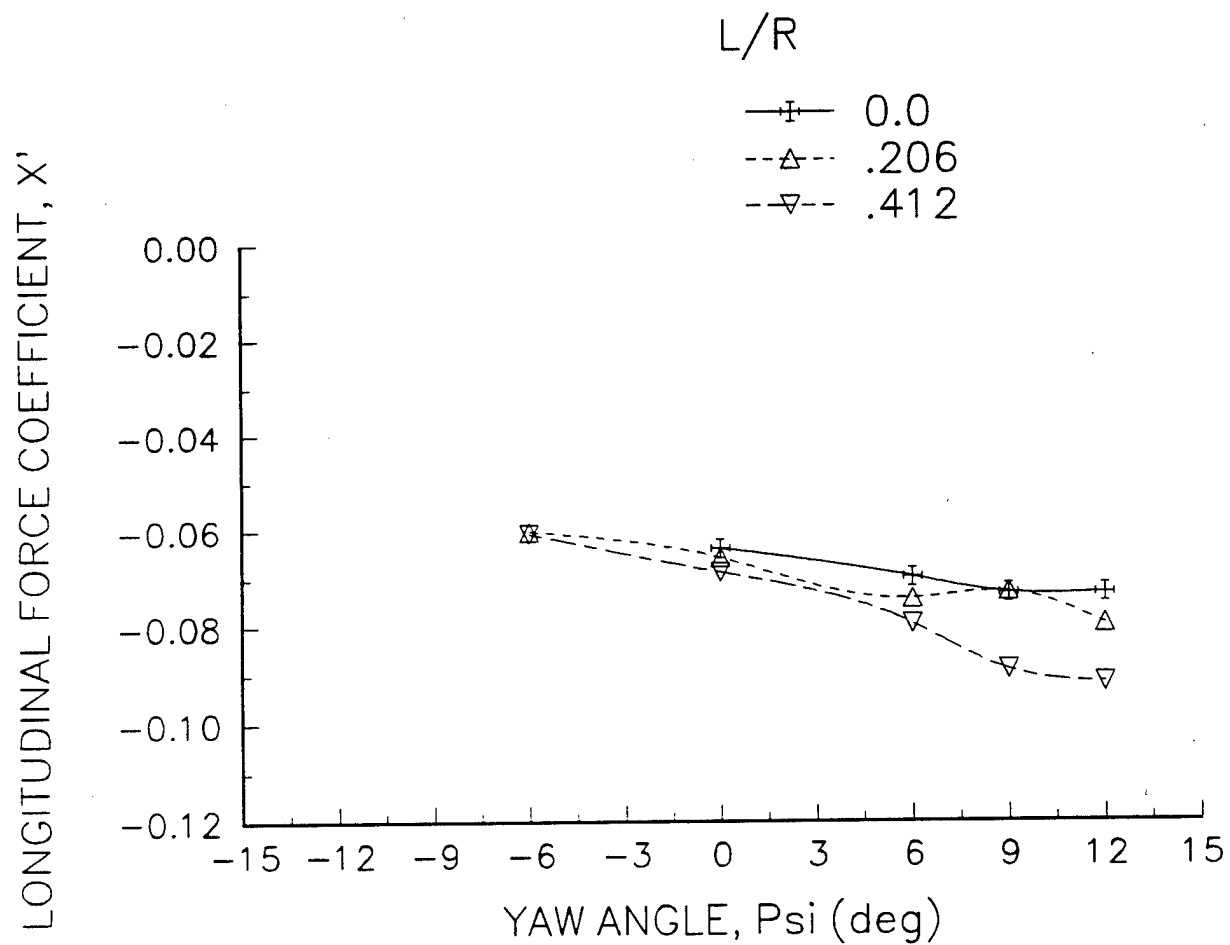


Figure D-7. X' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 20 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN
 Displacement 135 LTons
 Yaw Angle, Psi (deg) = -6, Speed = 12.5 Knots

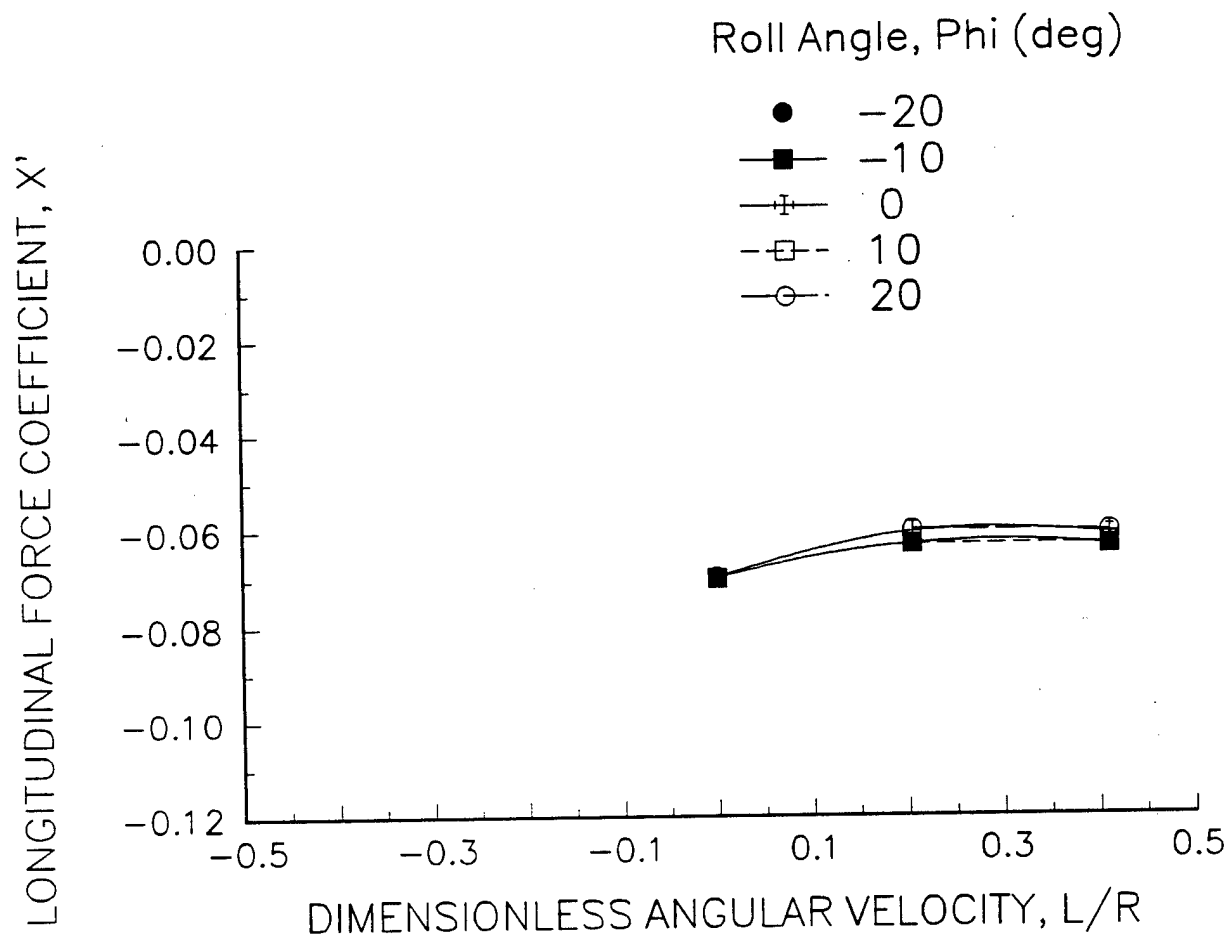


Figure D-8. X' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of -6 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN
Displacement 135 LTons
Yaw Angle, Psi (deg) = 0, Speed = 12.5 Knots

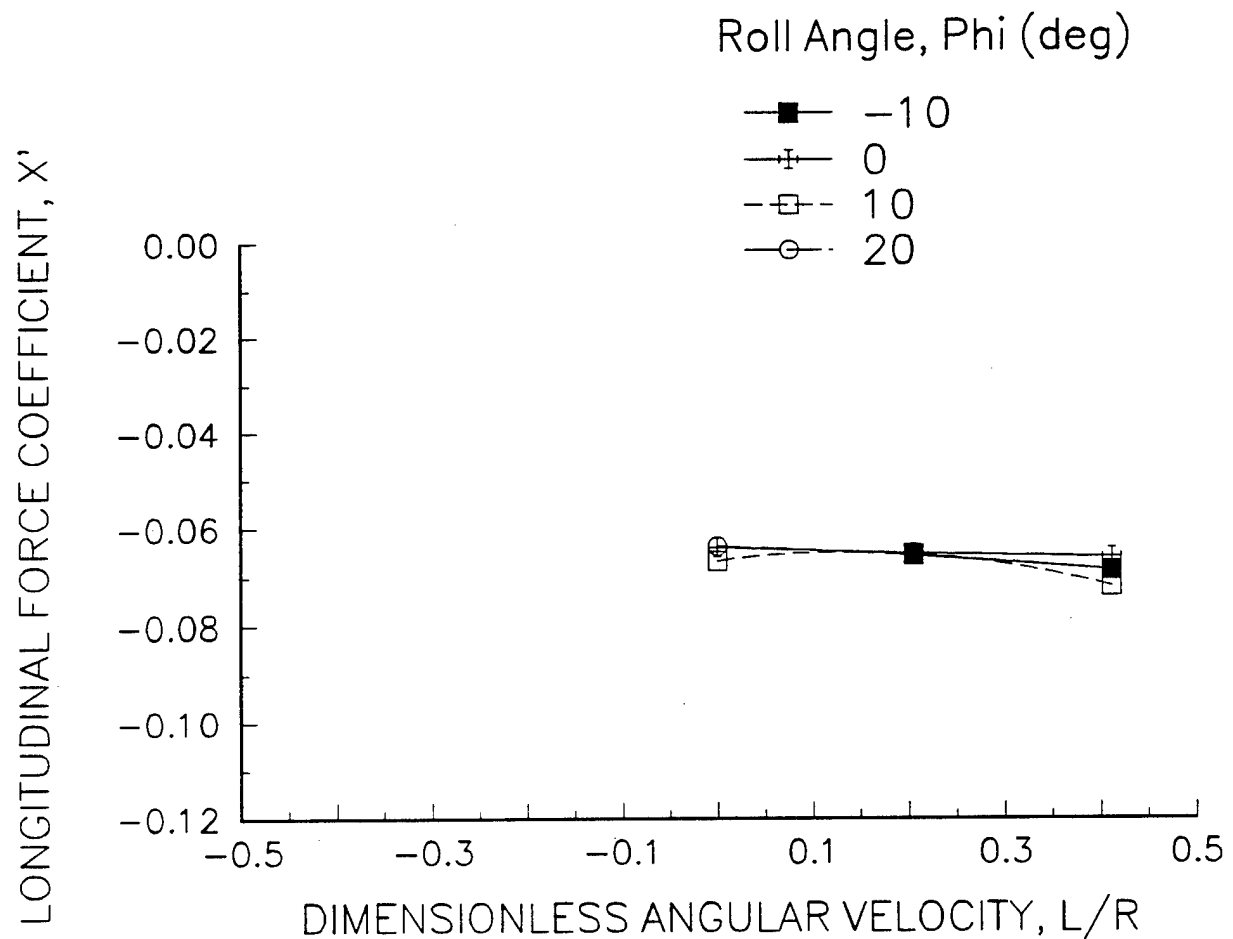


Figure D-9. X' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 0 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN
Displacement 135 LTons
Yaw Angle, Psi (deg) = 6, Speed = 12.5 Knots

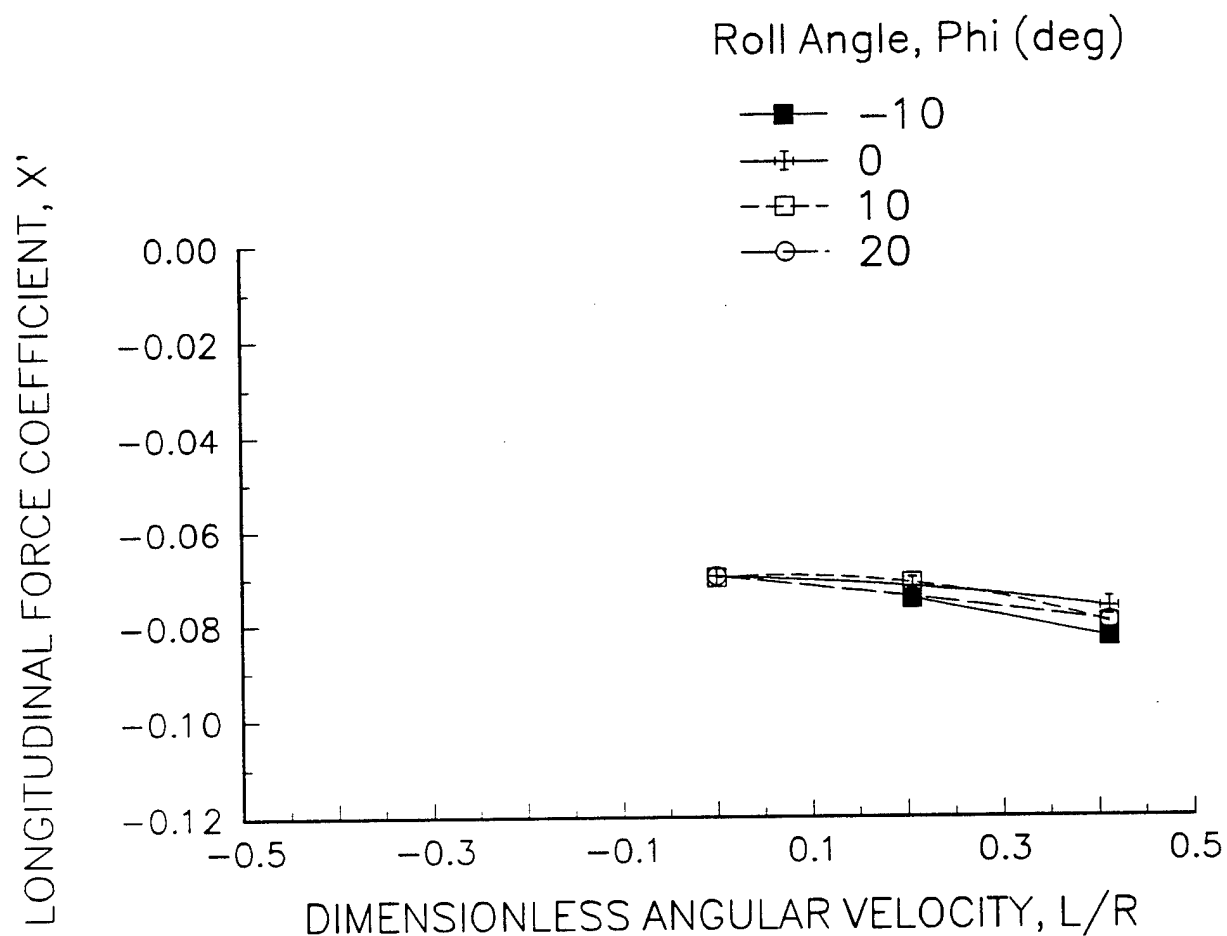


Figure D-10. X' versus L/R with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 6 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Yaw Angle, Psi (deg) = 9, Speed = 12.5 Knots

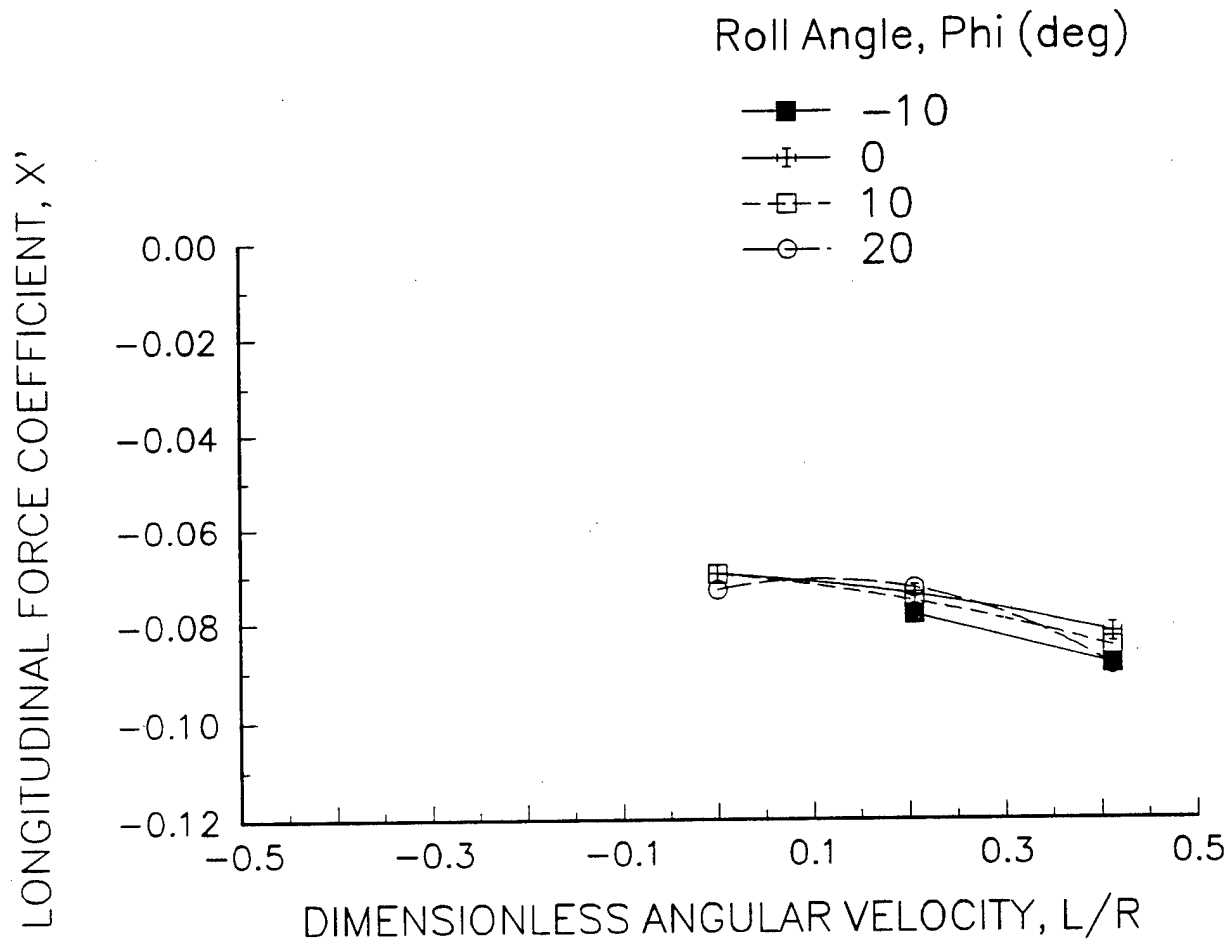


Figure D-11. X' versus L/R with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 9 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN
Displacement 135 L.Tons
Yaw Angle, Psi (deg) = 12, Speed = 12.5 Knots

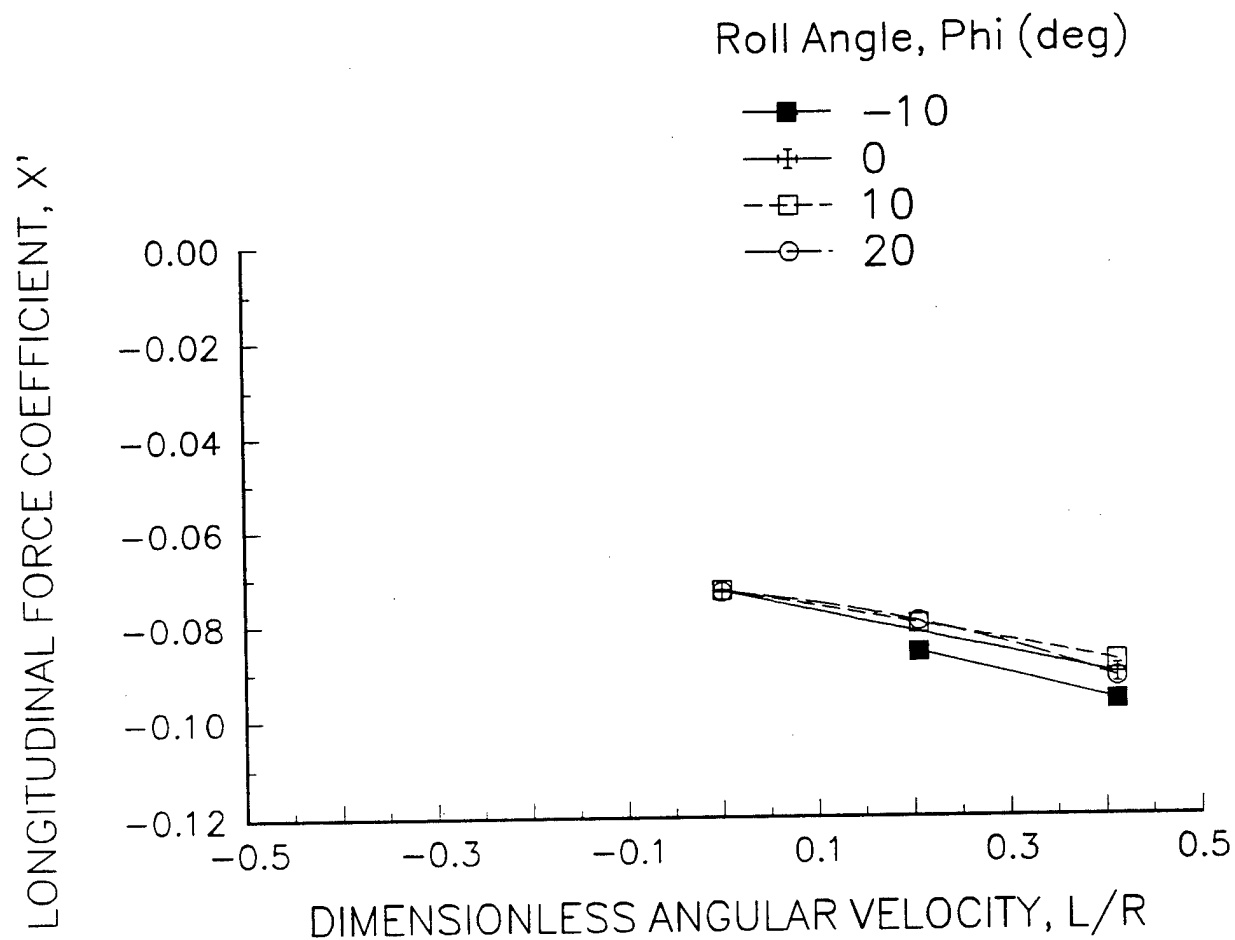


Figure D-12. X' versus L/R with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 12 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons
L/R=0, Speed = 35 Knots

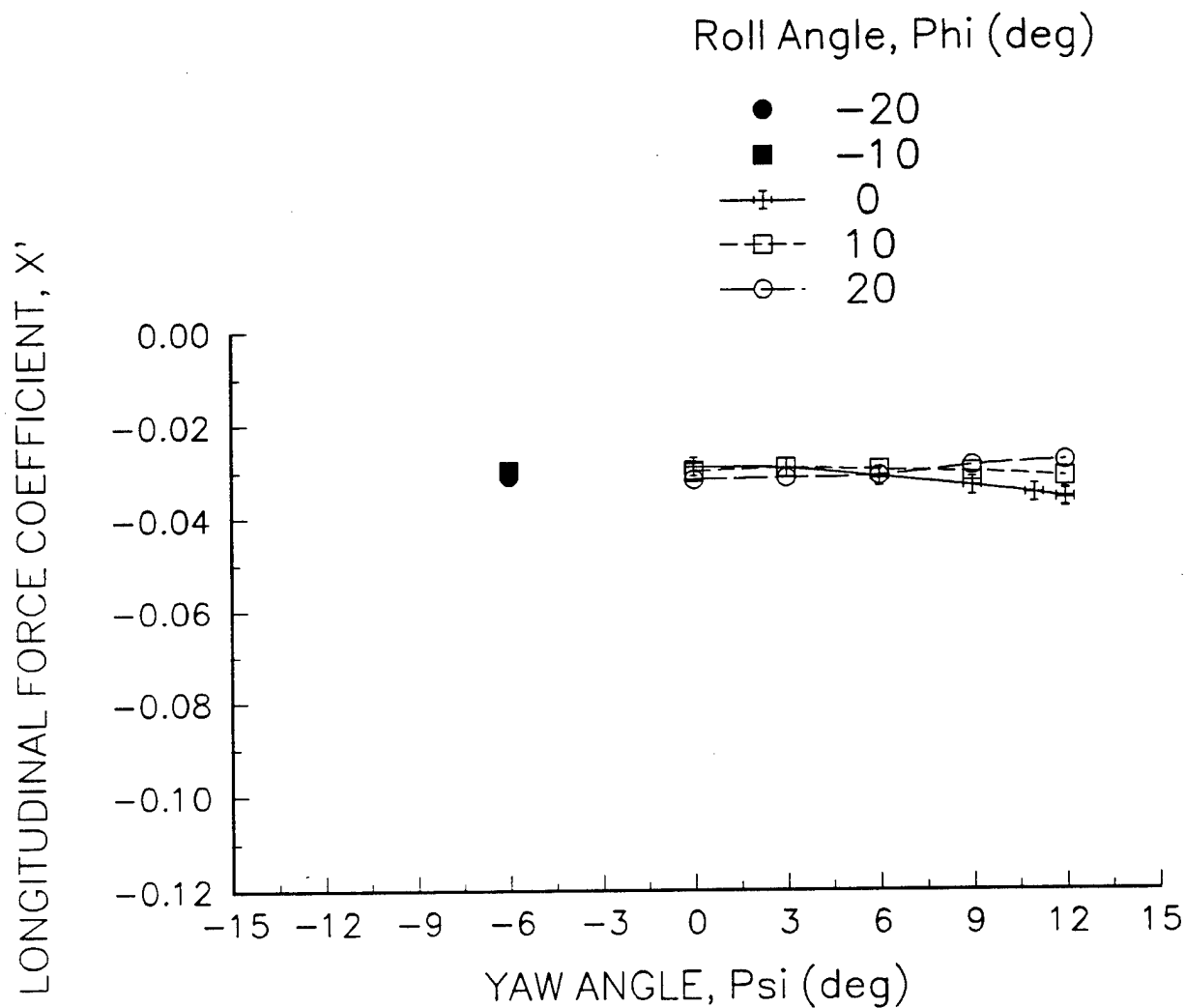


Figure D-13. X' versus Psi with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.000 and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

L/R=.206, Speed = 35 Knots

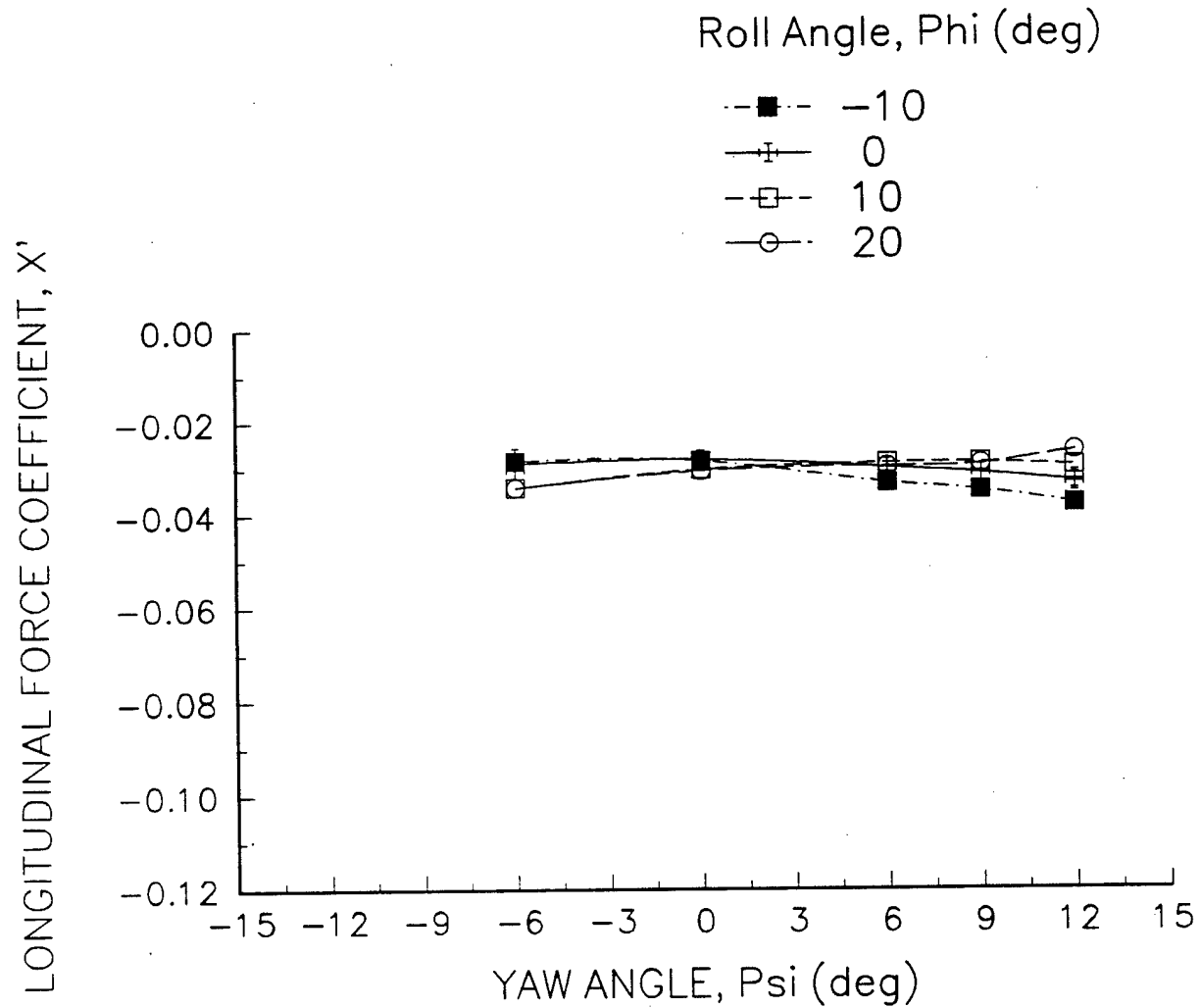


Figure D-14. X' versus Psi with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.206 and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

L/R=.412, Speed = 35 Knots

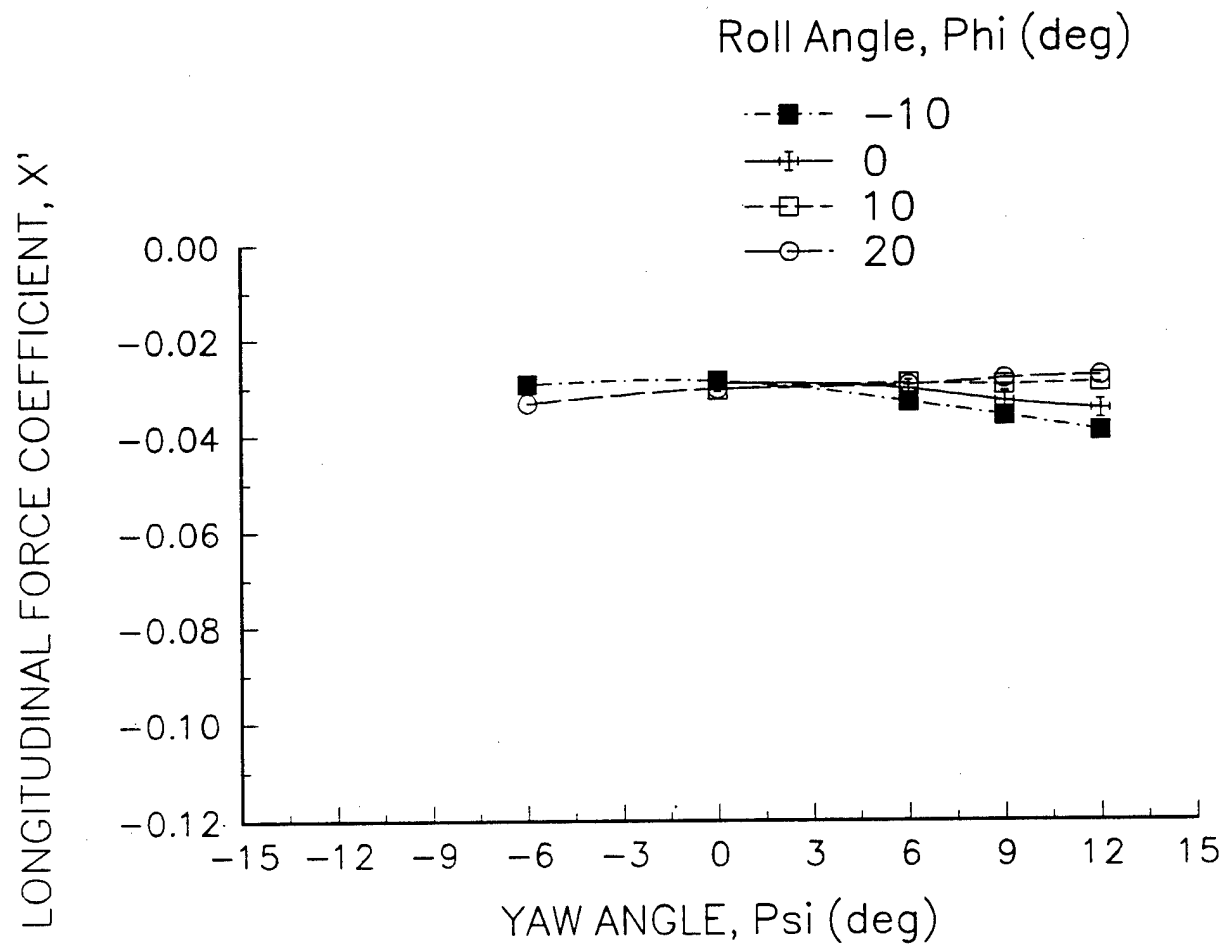


Figure D-15. X' versus Psi with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.412 and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN
 Displacement 135 LTons
 ROLL ANGLE, Φ (deg) = -10, Speed = 35 Knots

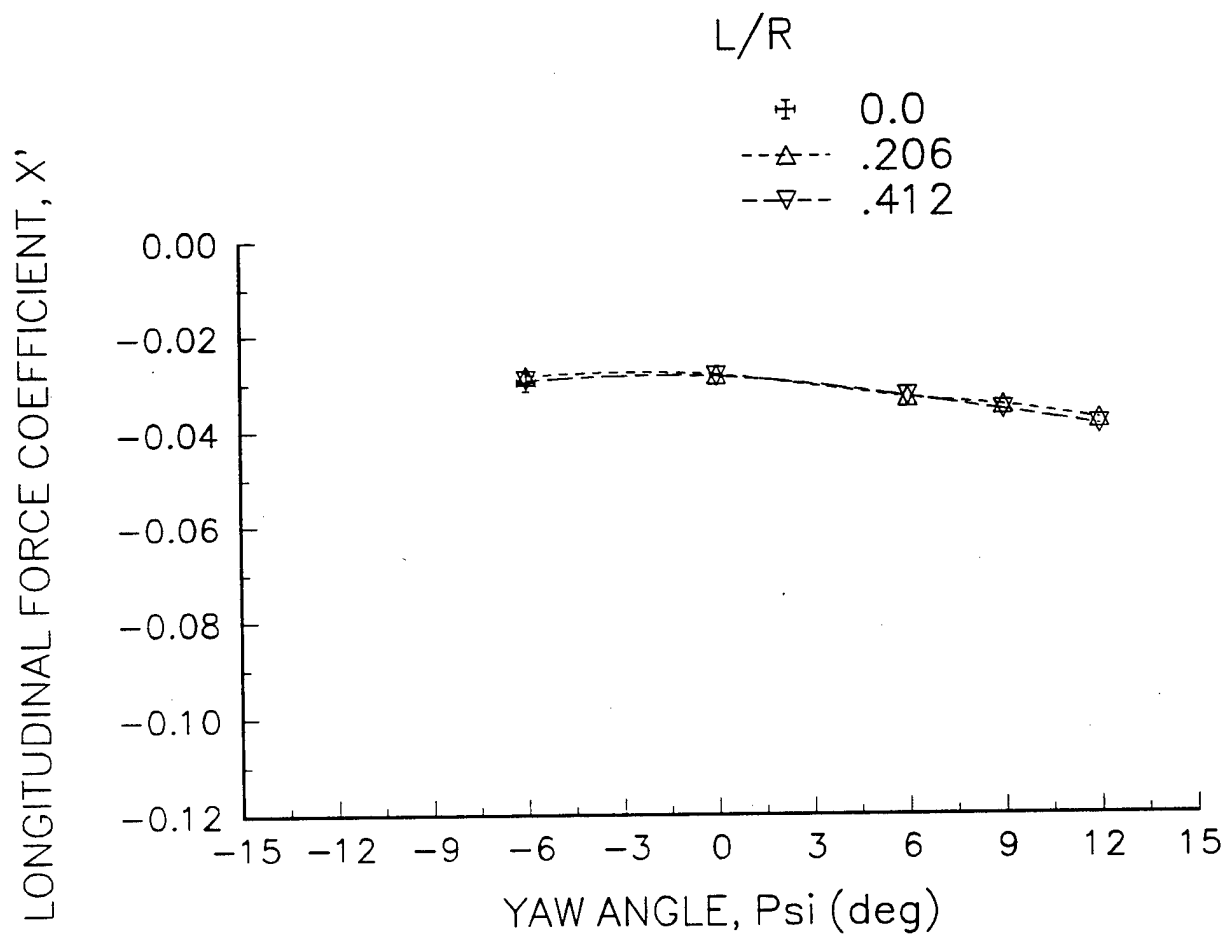


Figure D-16. X' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of -10 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN
Displacement 135 LTons
ROLL ANGLE, Φ (deg) = 0, Speed = 35 Knots

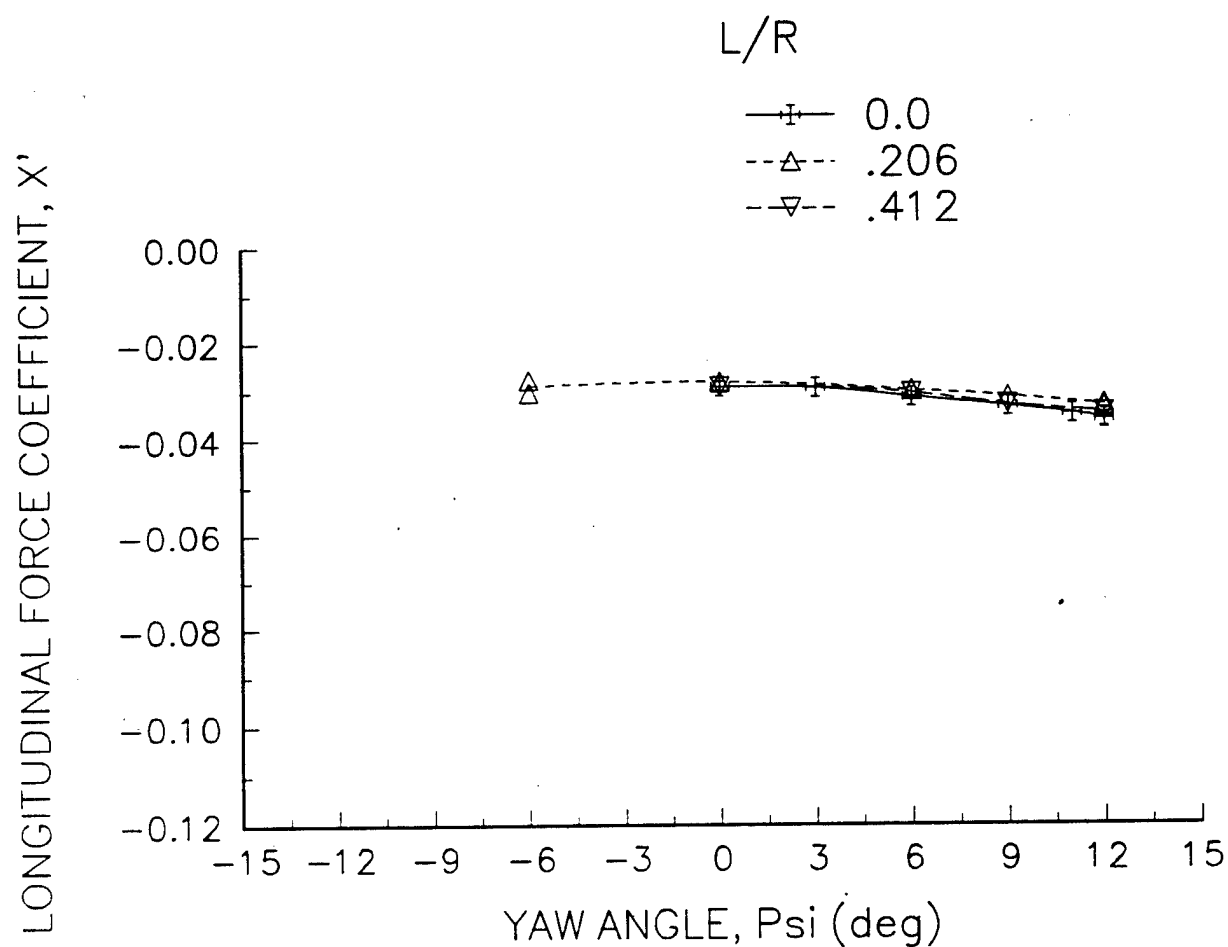


Figure D-17. X' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 0 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN
Displacement 135 LTons
ROLL ANGLE, Φ (deg) = 10, Speed = 35 Knots

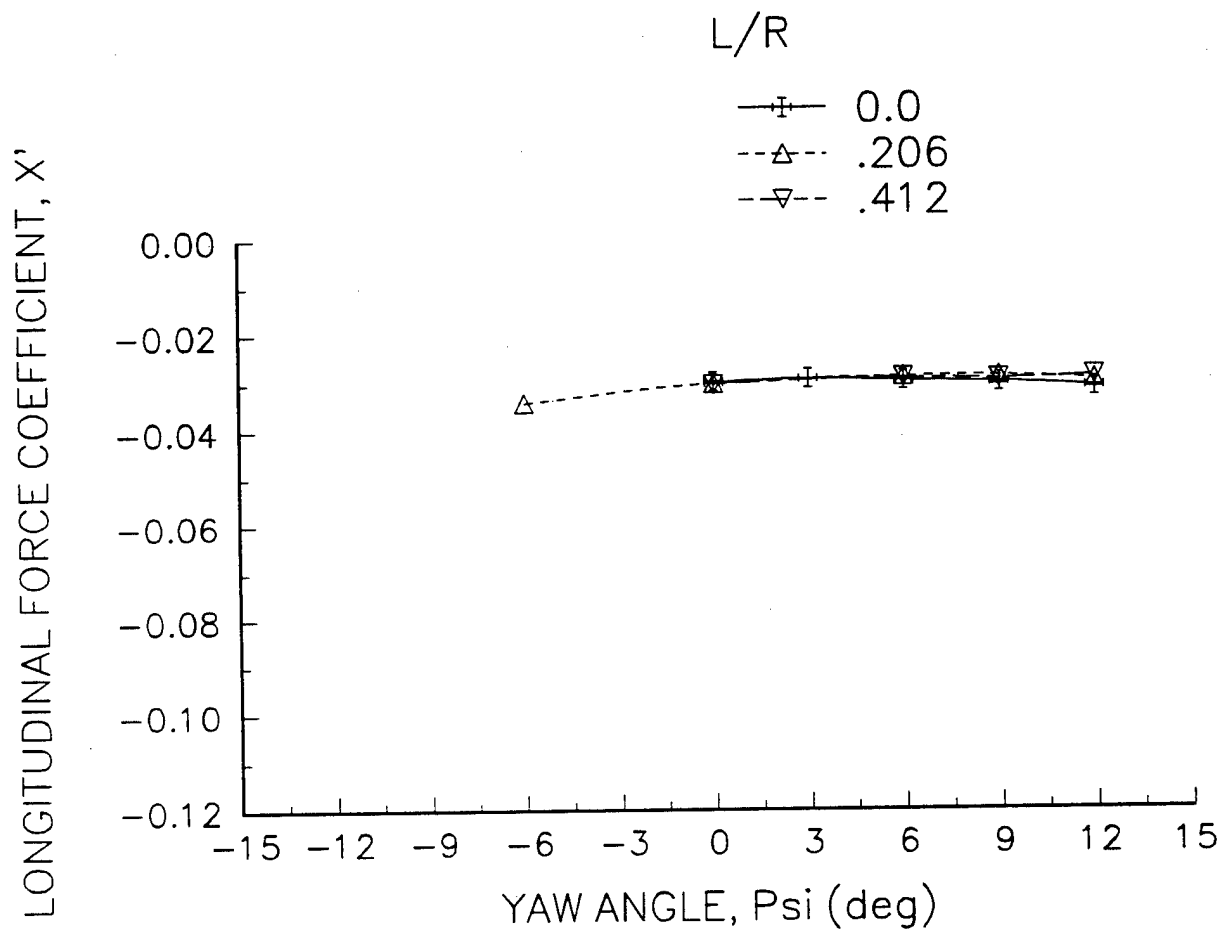


Figure D-18. X' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 10 degrees and a speed of 35 knots.

1 20 FT NOTIONAL WPB DESIGN
Displacement 1 35 LTons
ROLL ANGLE, Φ (deg) = 20, Speed = 35 Knots

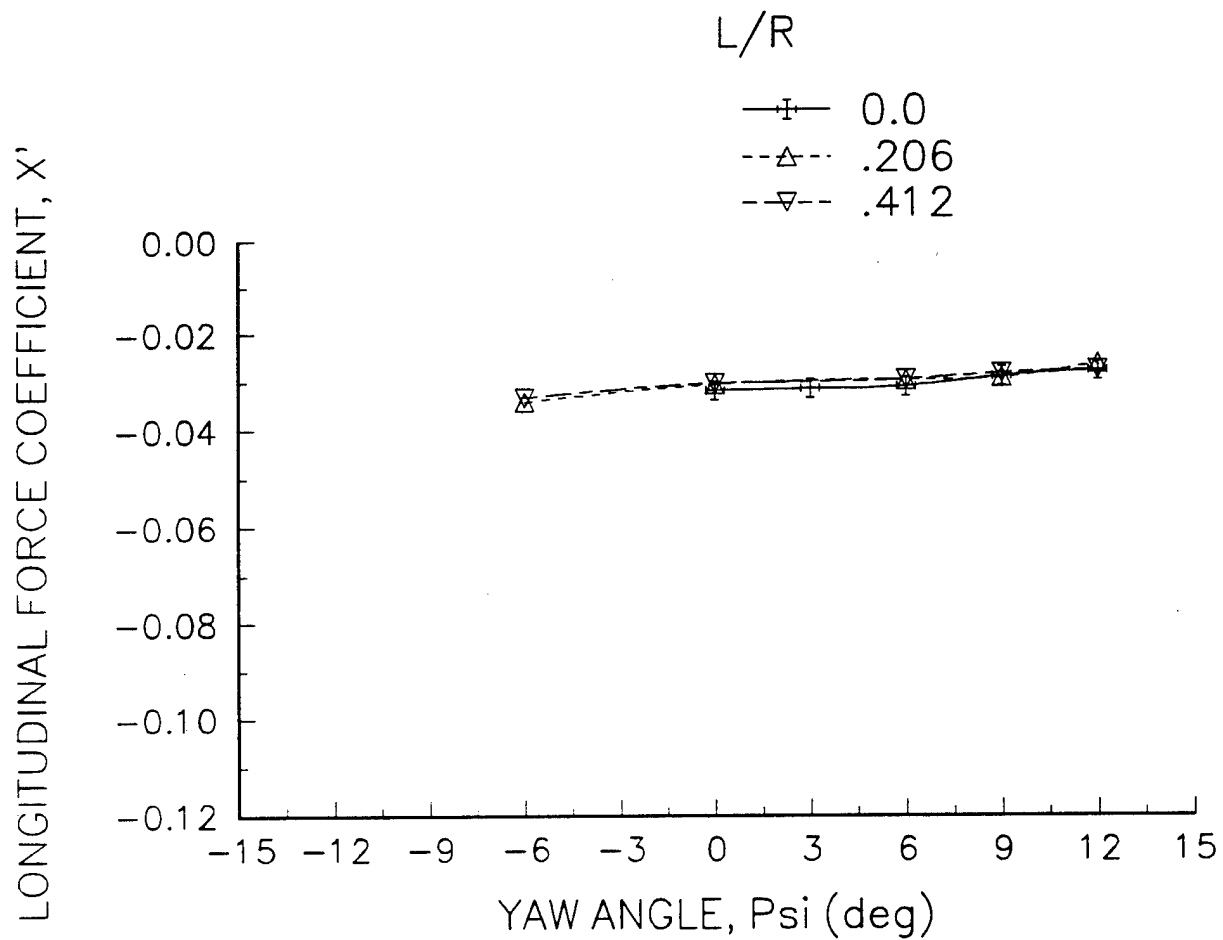


Figure D-19. X' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 20 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Yaw Angle, Psi (deg) = -6, Speed = 35 Knots

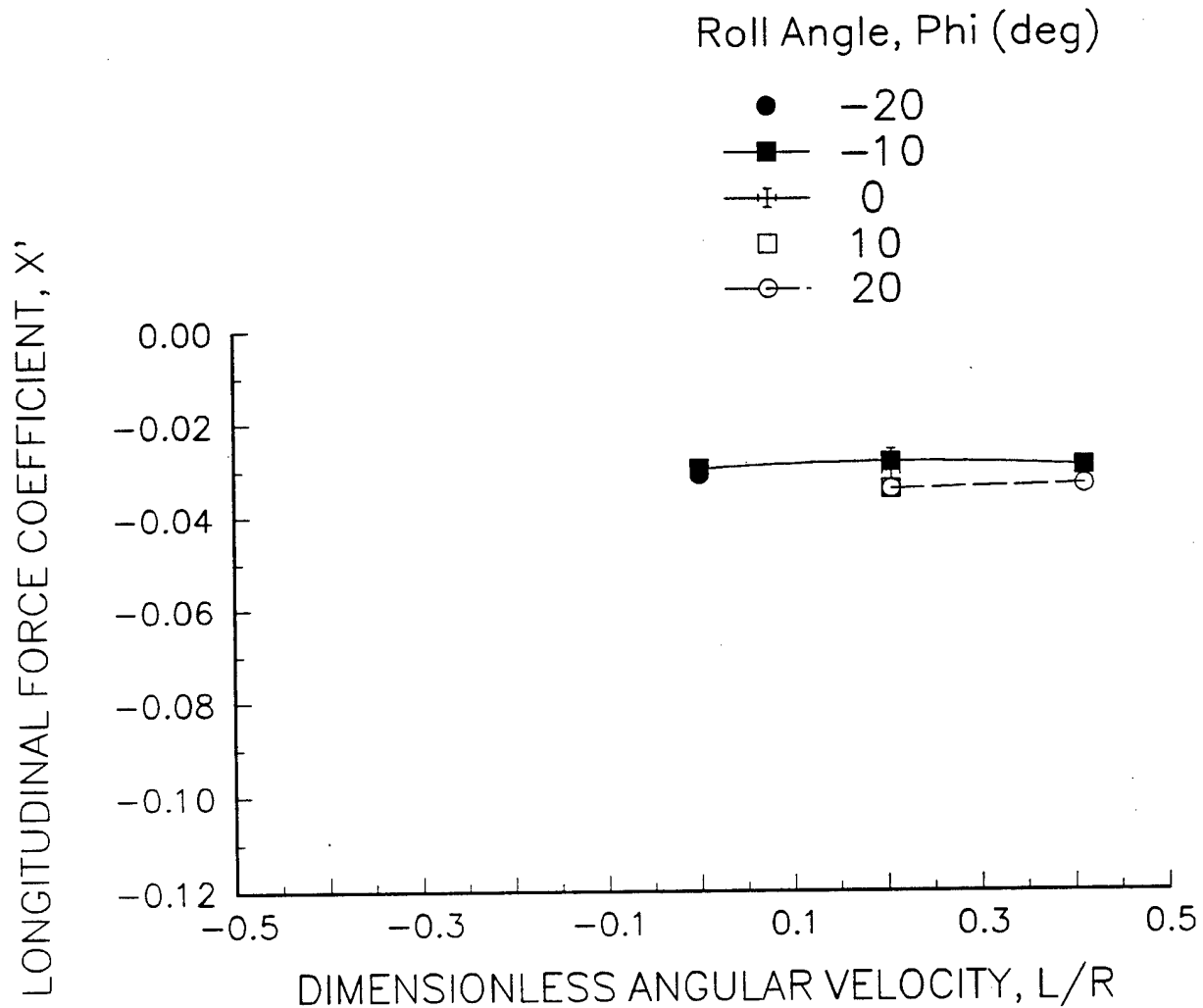


Figure D-20. X' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of -6 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN
 Displacement 135 LTons
 Yaw Angle, Psi (deg) = 0, Speed = 35 Knots

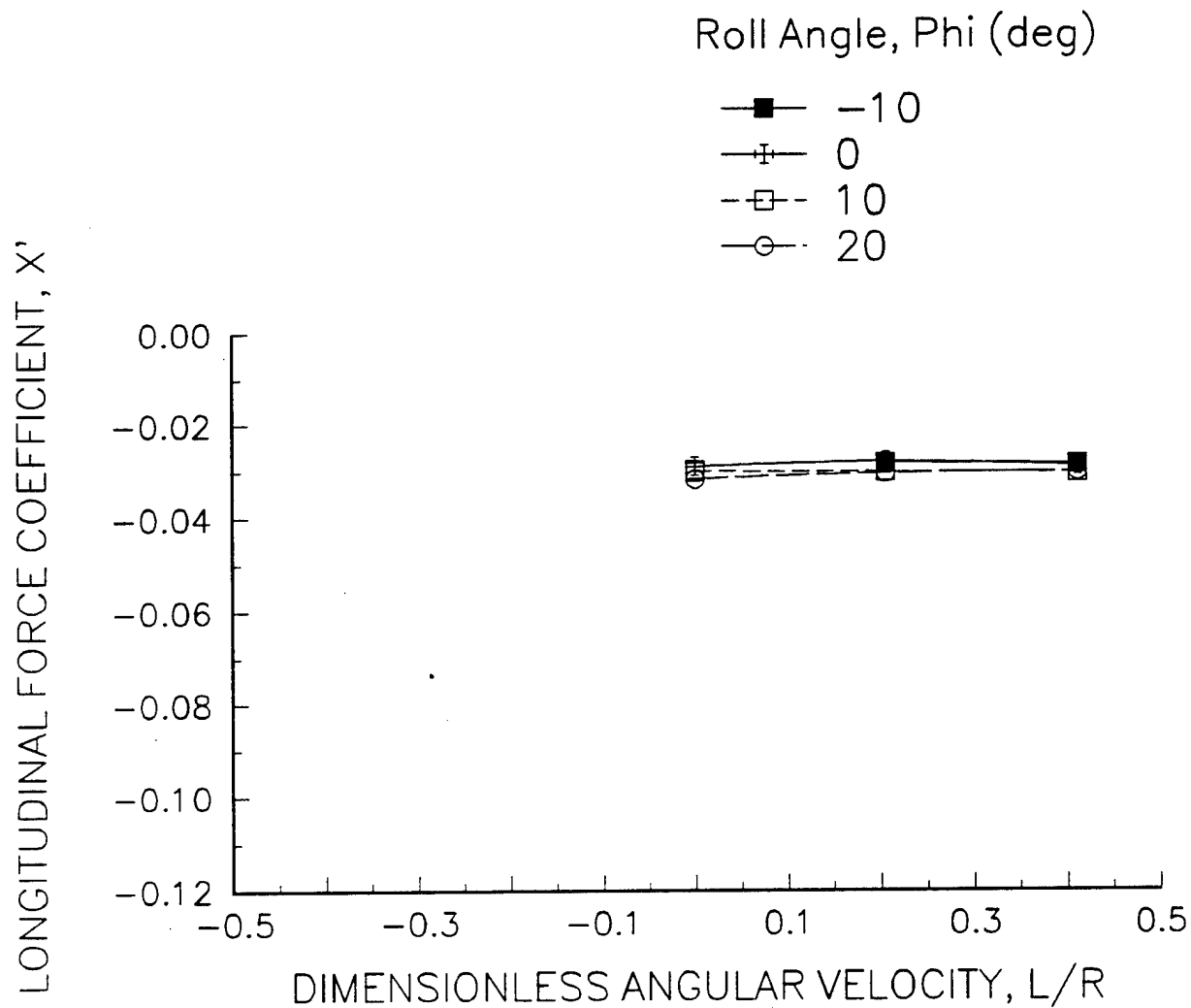


Figure D-21. X' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 0 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Yaw Angle, Psi (deg) = 6, Speed = 35 Knots

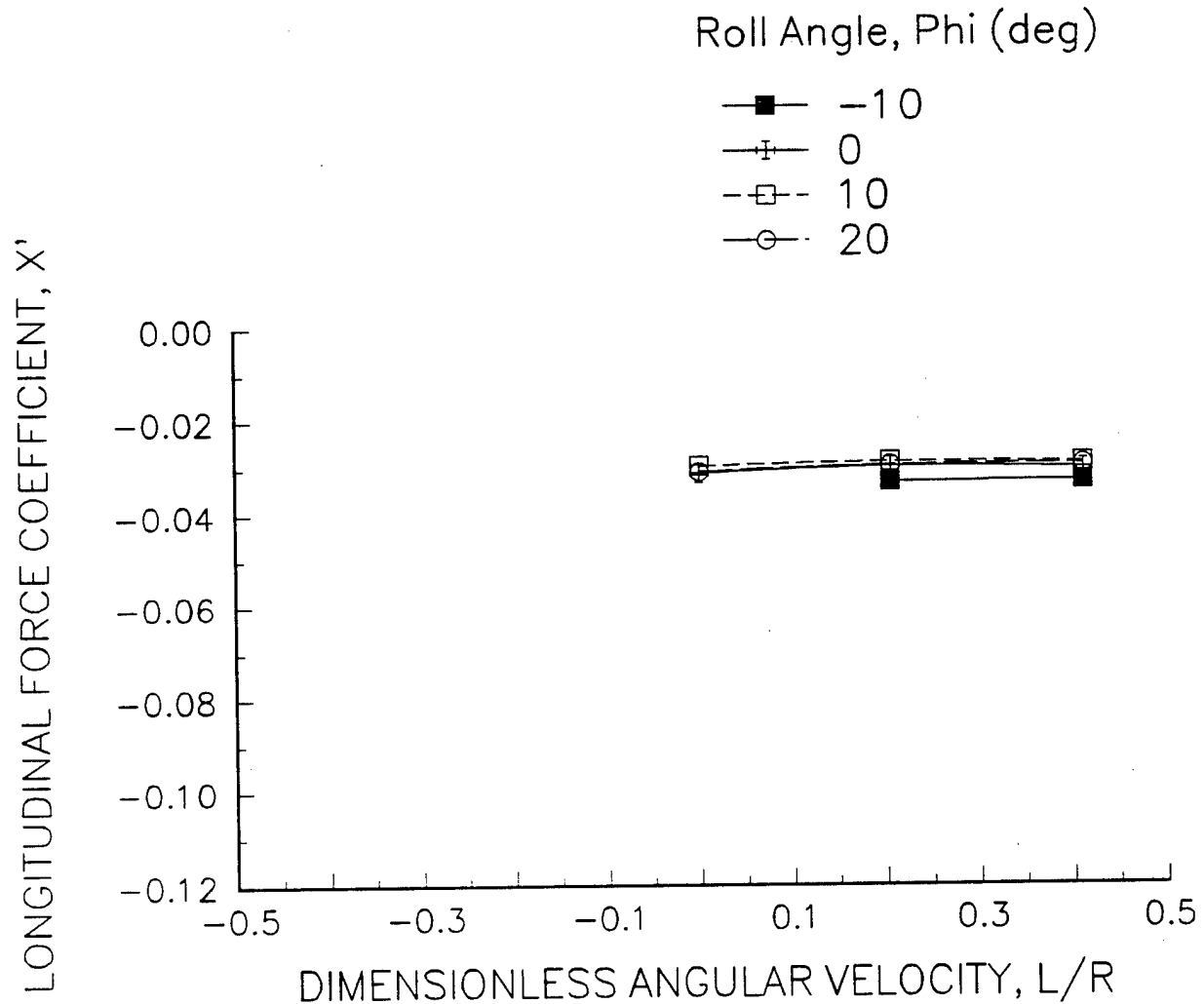


Figure D-22. X' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 6 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Yaw Angle, Psi (deg) = 9, Speed = 35 Knots

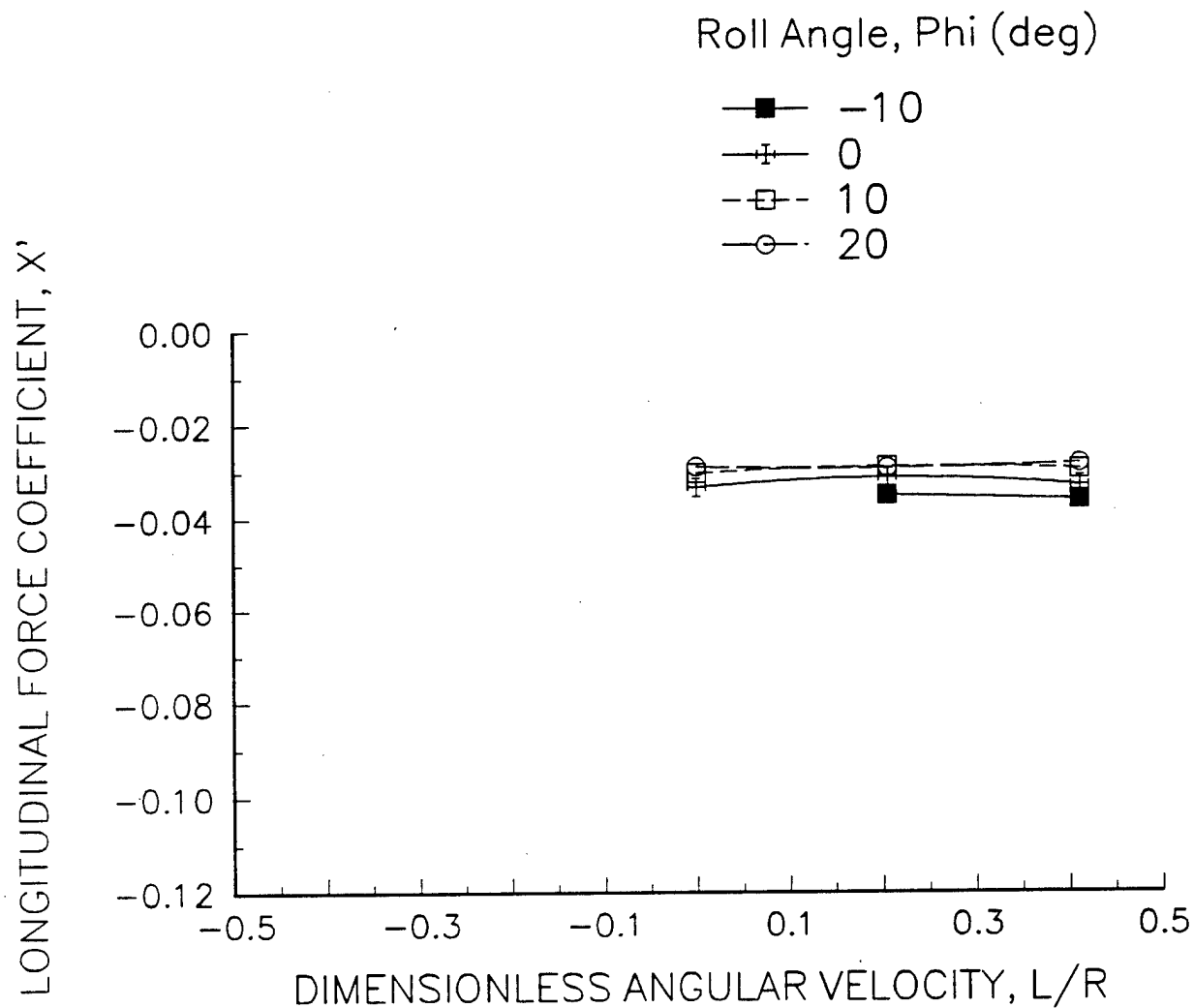


Figure D-23. X' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 9 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Yaw Angle, Psi (deg) = 12, Speed = 35 Knots

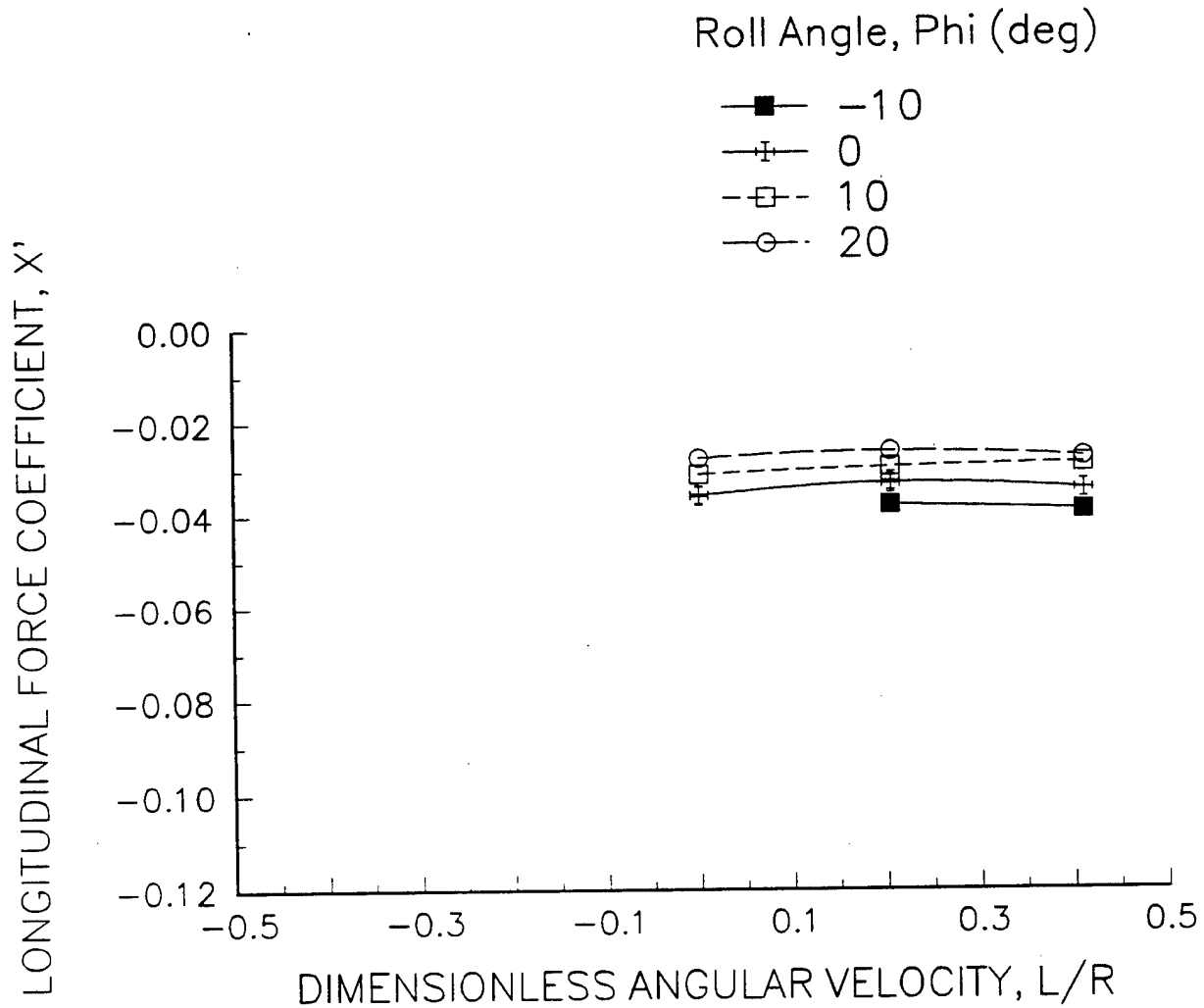


Figure D-24. X' versus L/R with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 12 degrees and a speed of 12.5 knots.

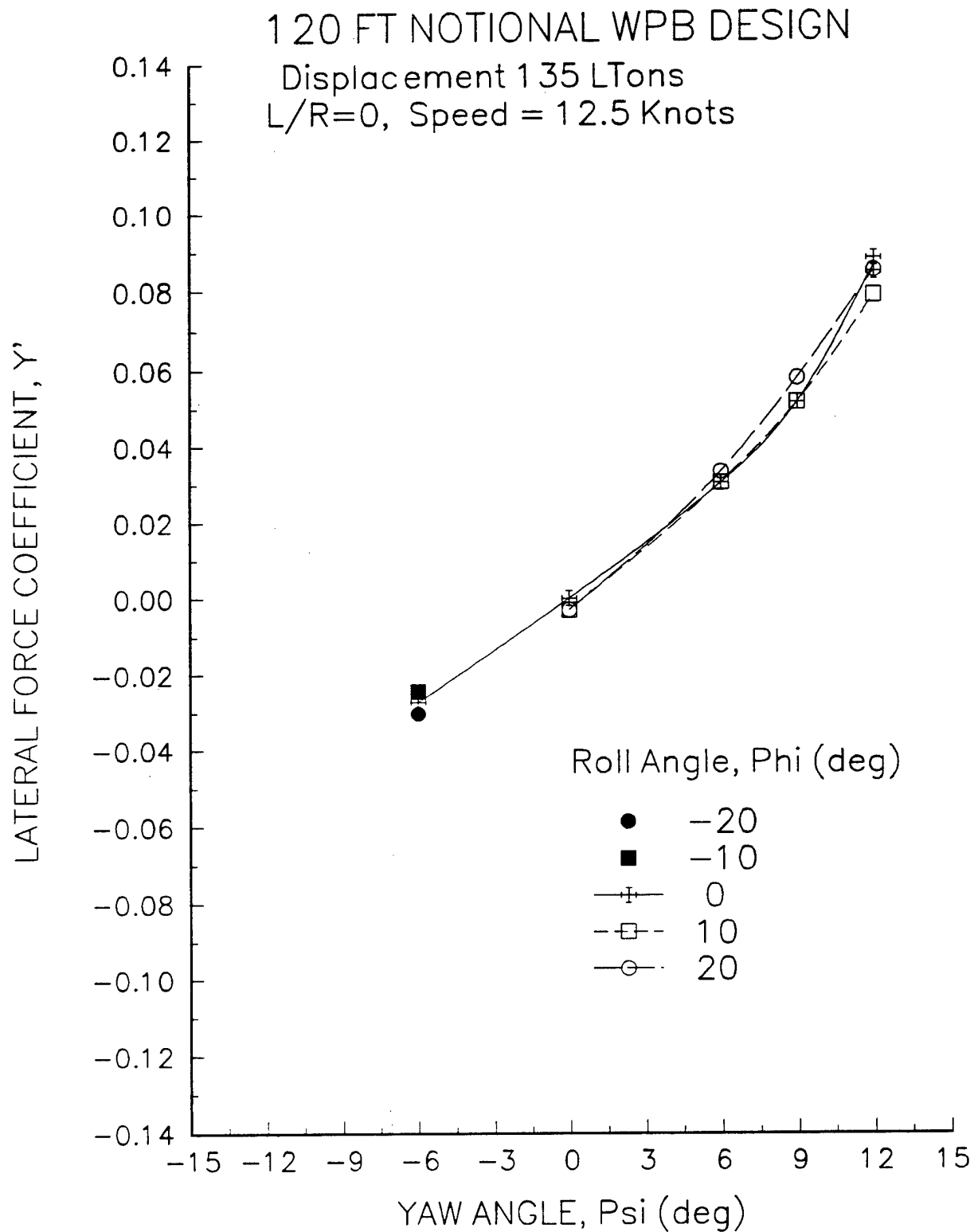


Figure D-25. Y' versus Ψ with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.000 and a speed of 12.5 knots.

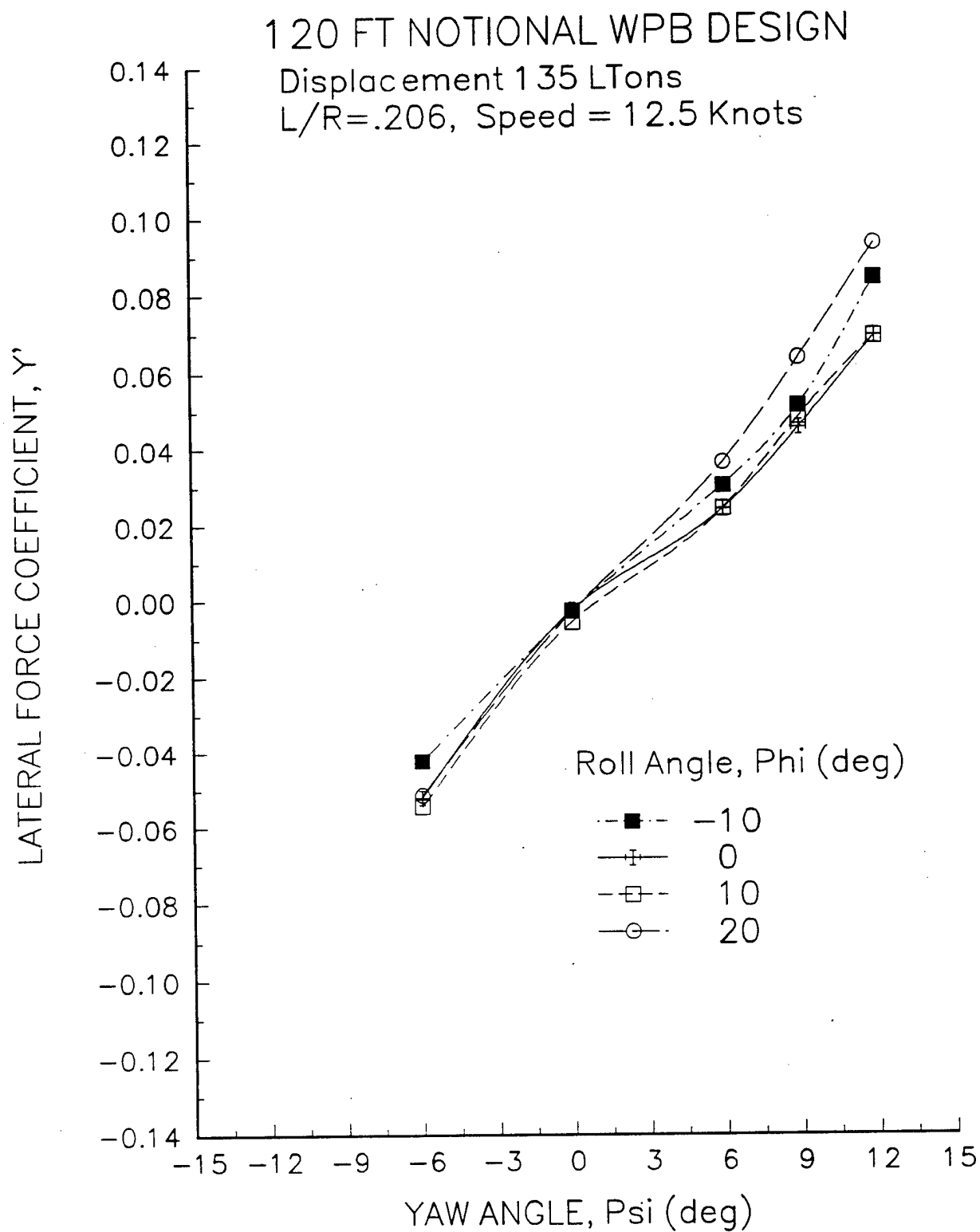


Figure D-26. Y' versus Psi with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.206 and a speed of 12.5 knots.

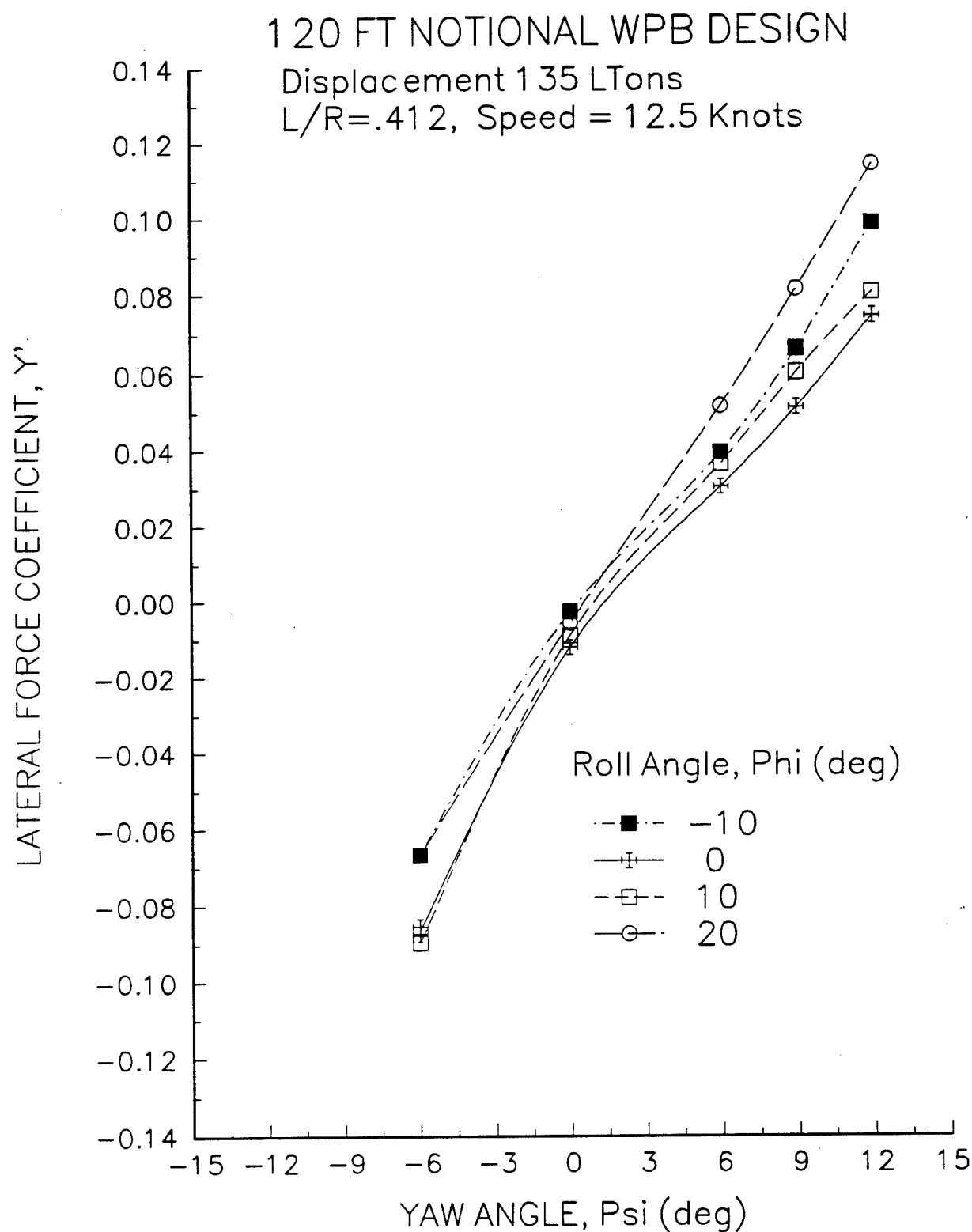


Figure D-27. Y' versus Ψ with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.412 and a speed of 12.5 knots.

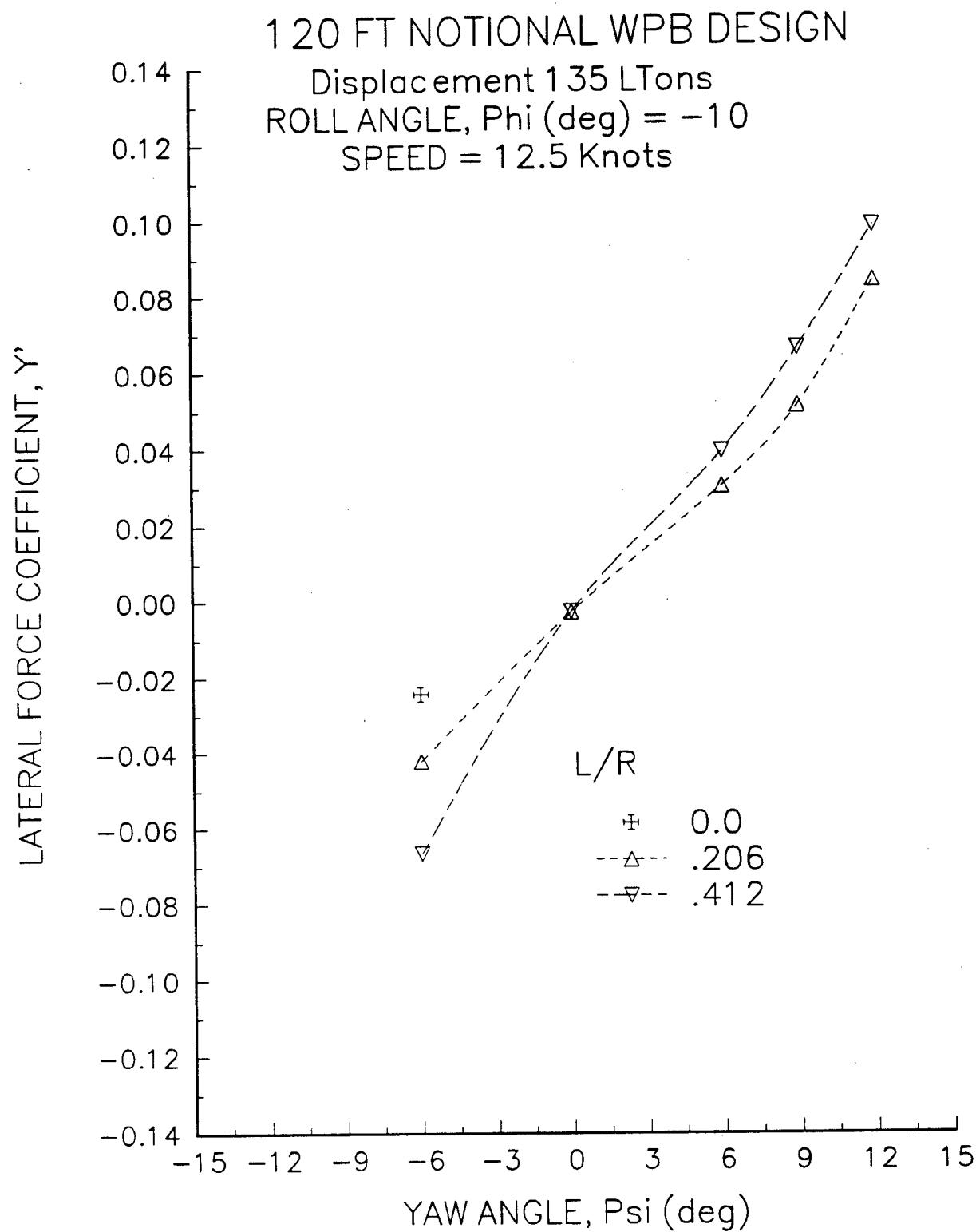


Figure D-28. Y' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of -10 degrees and a speed of 12.5 knots.

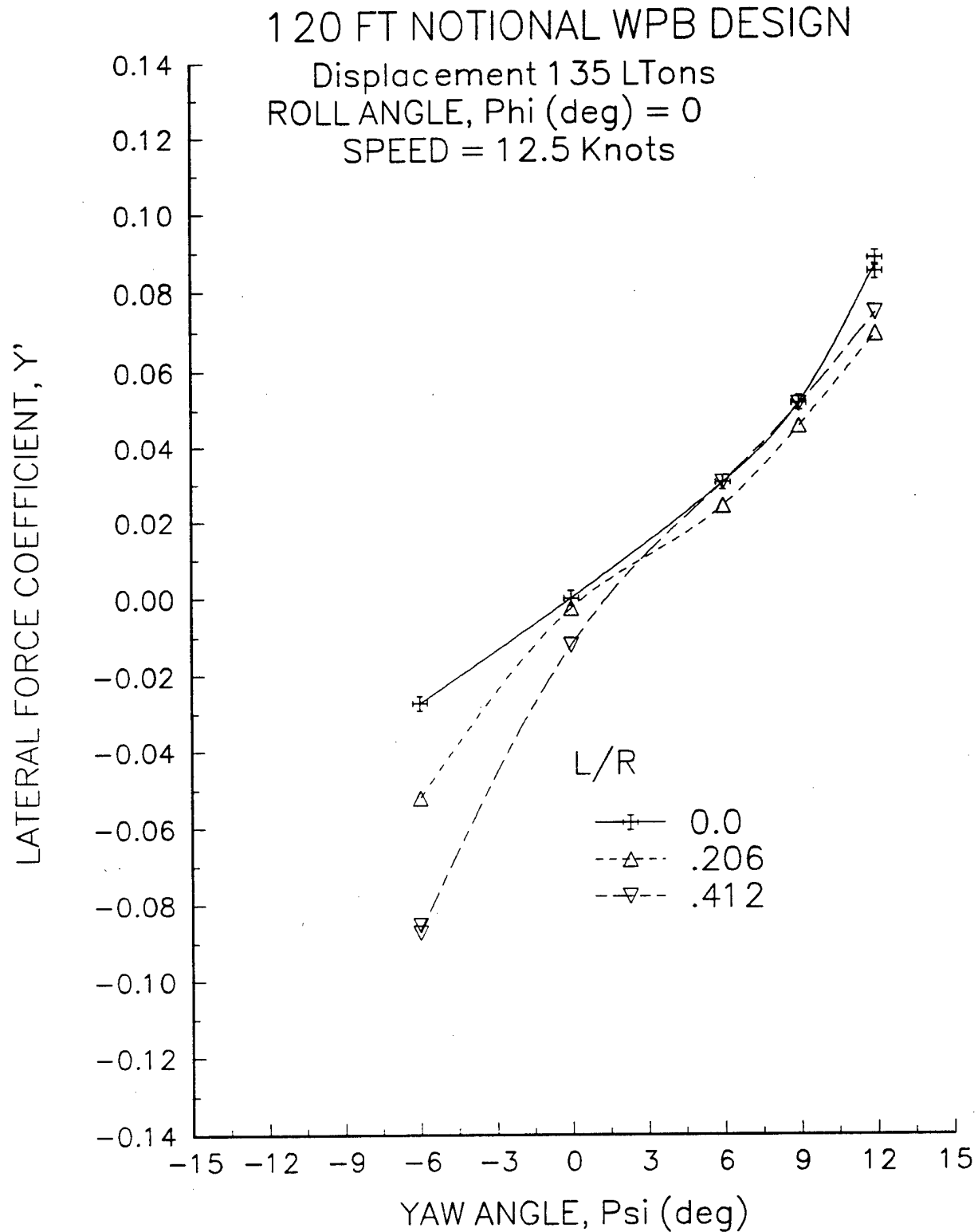


Figure D-29. Y' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 0 degrees and a speed of 12.5 knots.

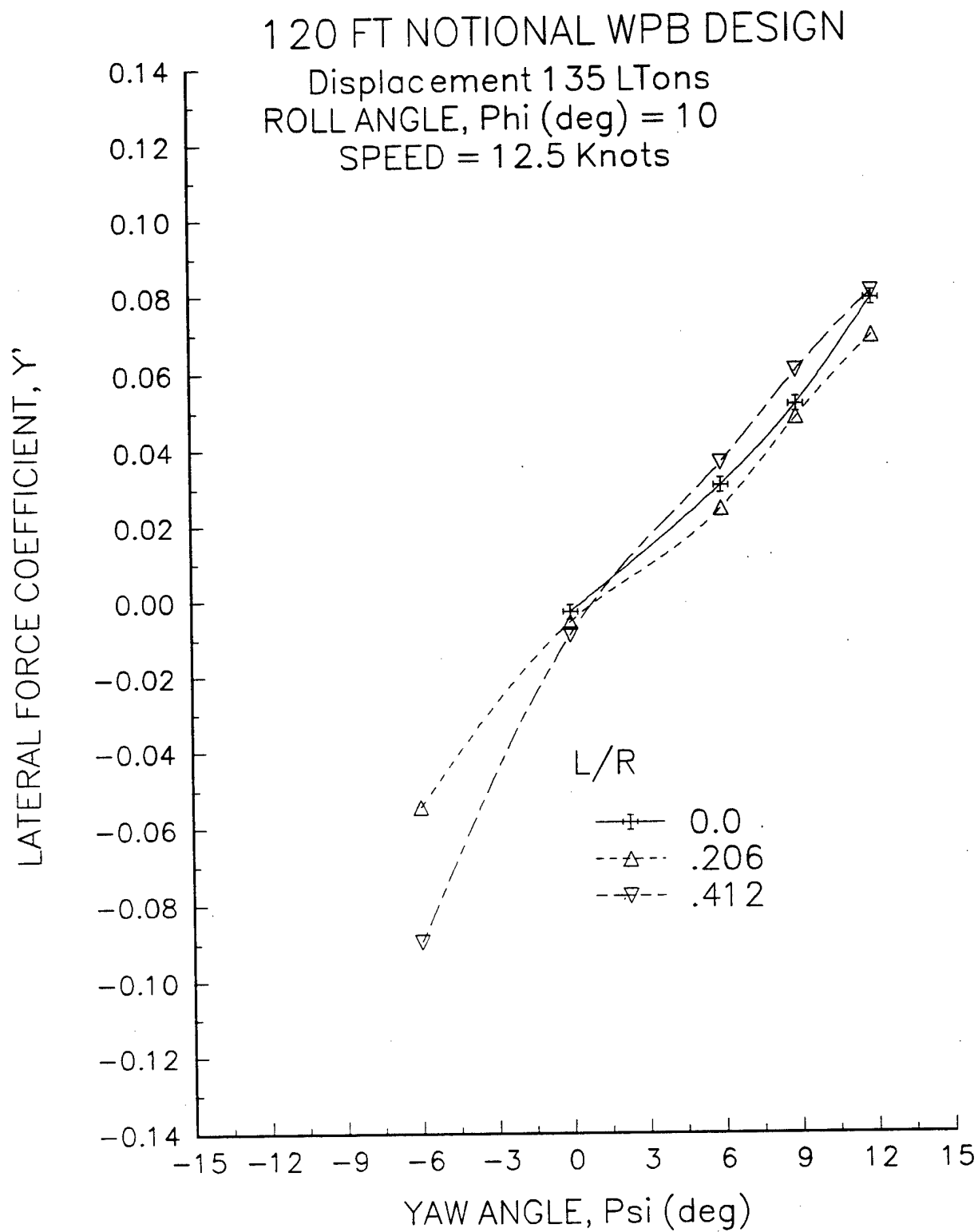


Figure D-30. Y' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 10 degrees and a speed of 12.5 knots.

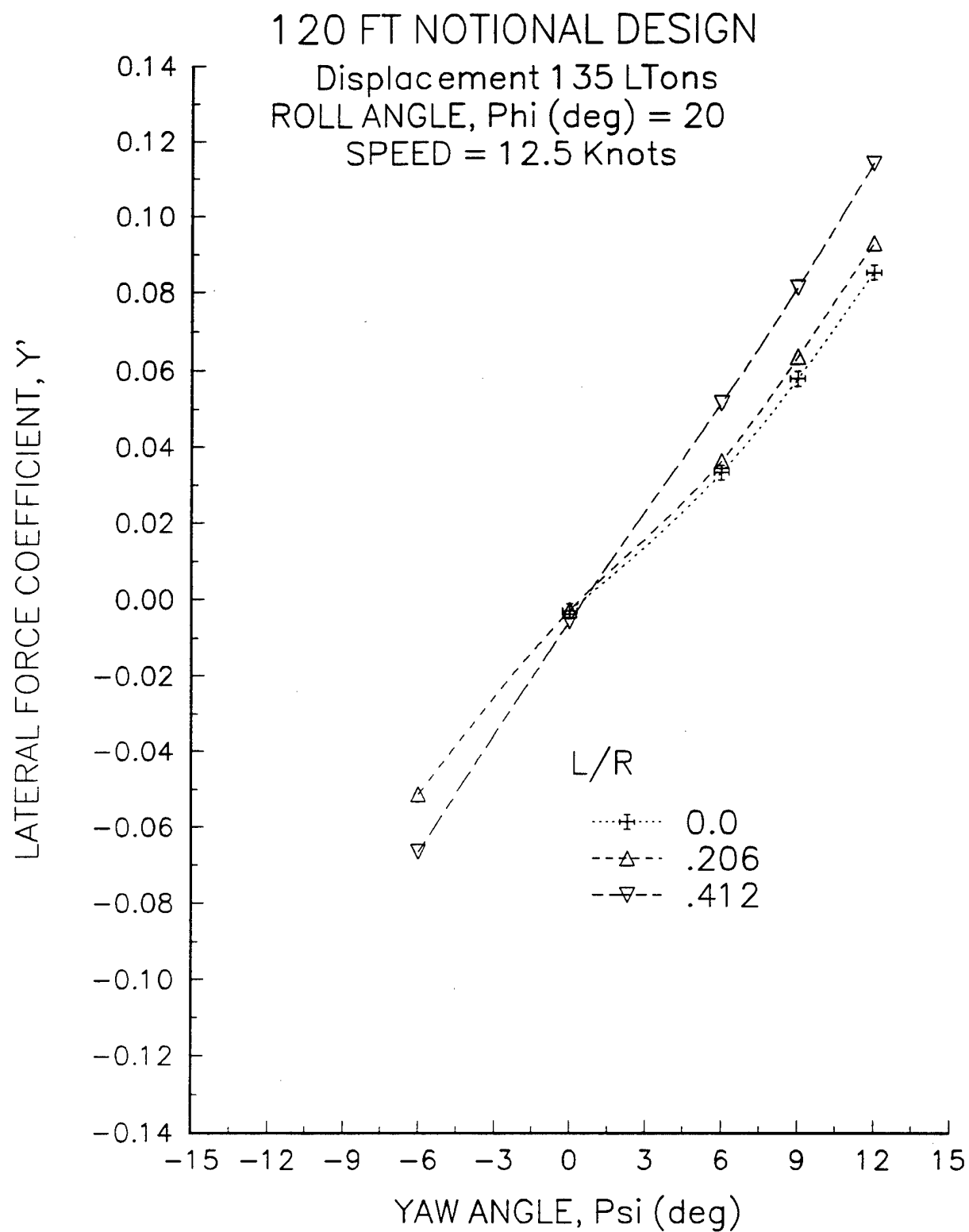


Figure D-31. Y' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 20 degrees and a speed of 12.5 knots.

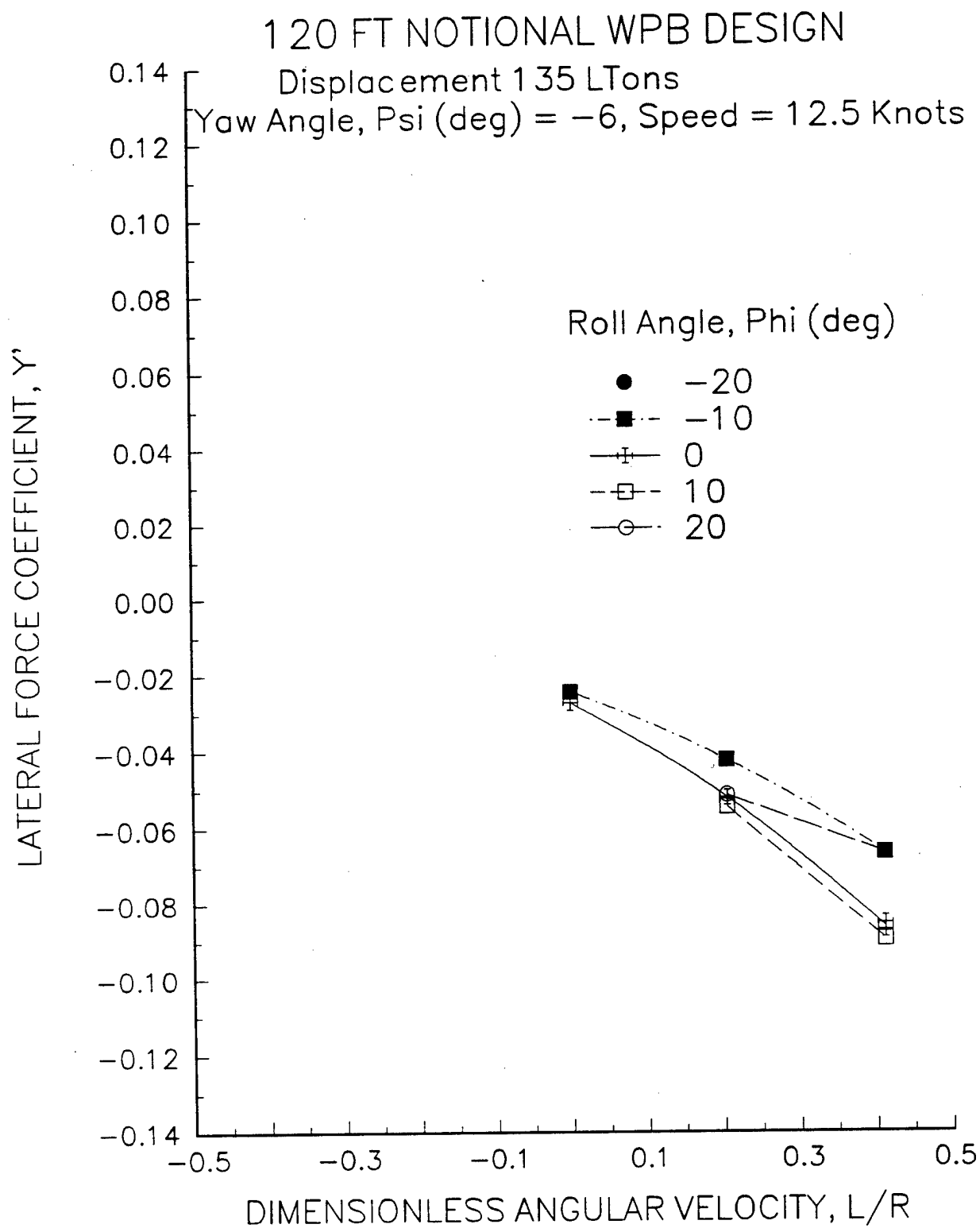


Figure D-32. Y' versus L/R with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of -6 degrees and a speed of 12.5 knots.

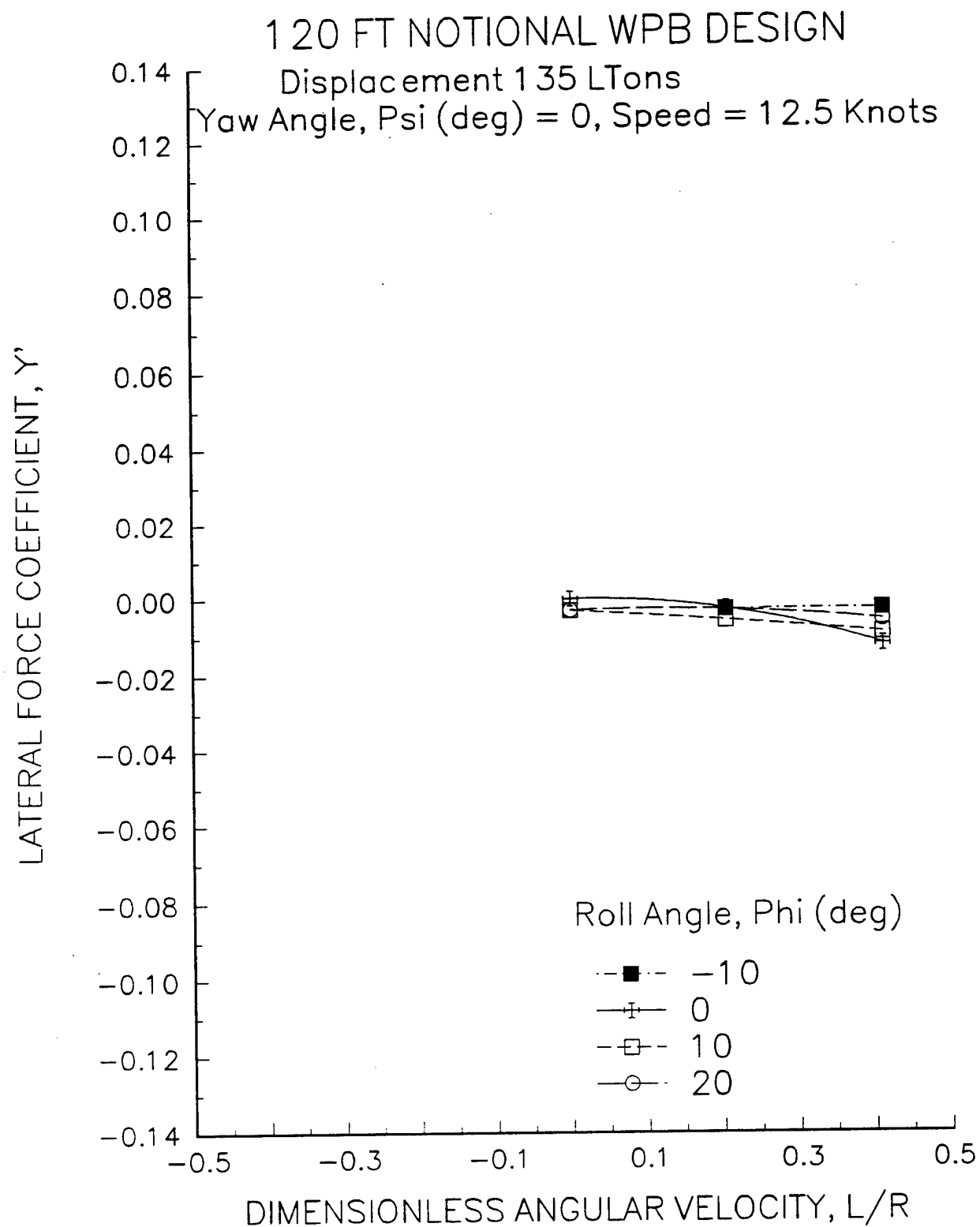


Figure D-33. Y' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 0 degrees and a speed of 12.5 knots.

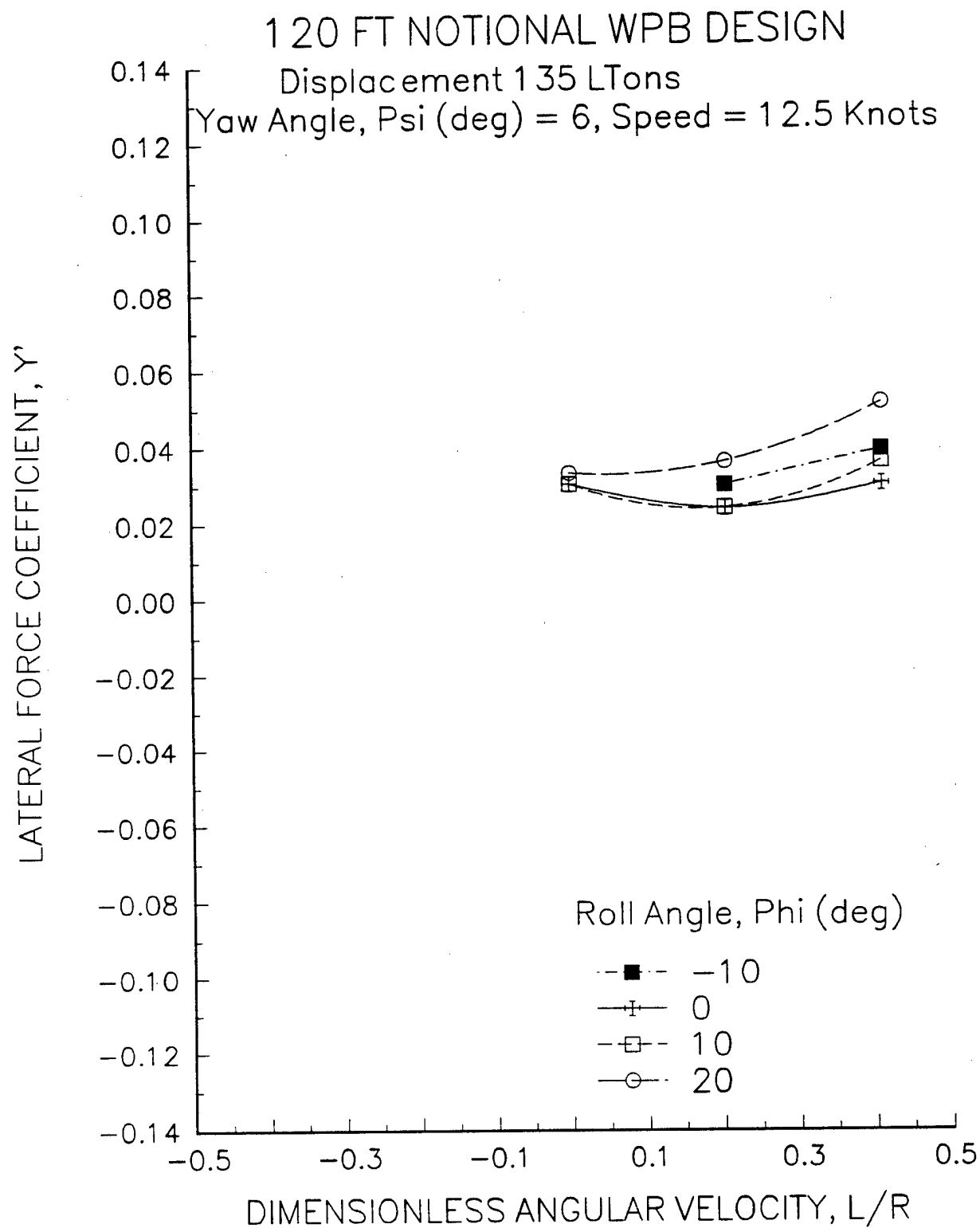


Figure D-34. Y' versus L/R with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 6 degrees and a speed of 12.5 knots.

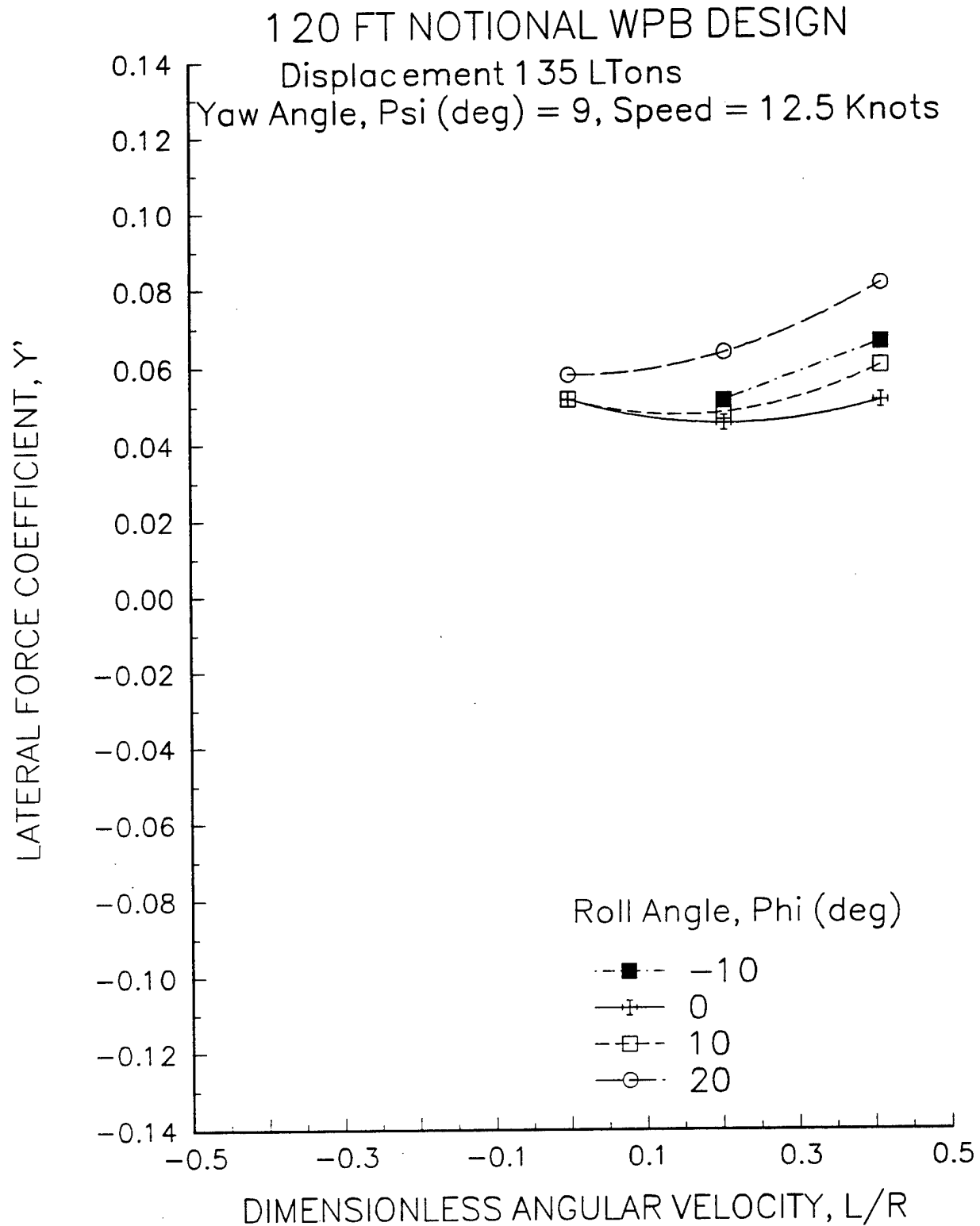


Figure D-35. Y' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 9 degrees and a speed of 12.5 knots.

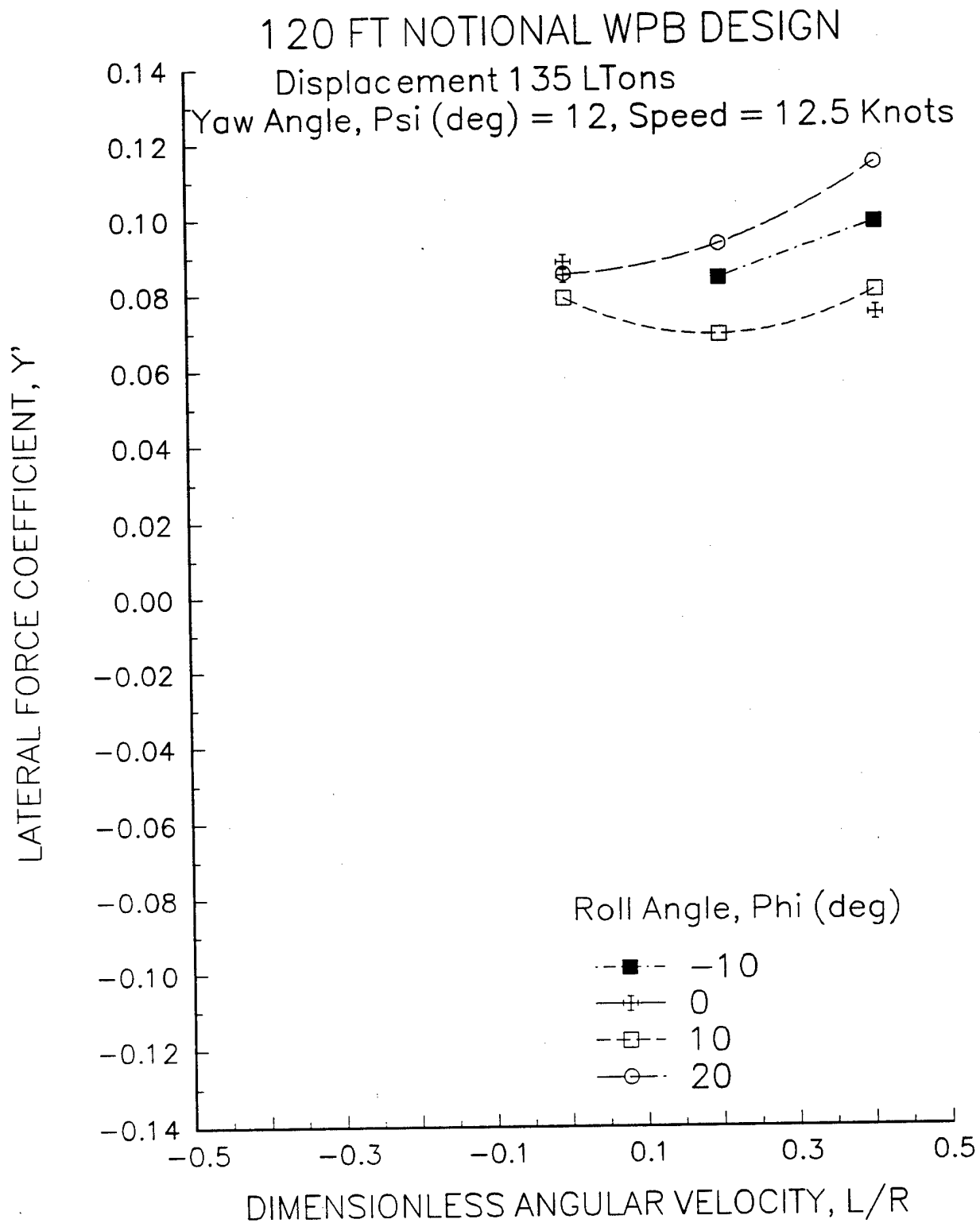


Figure D-36. Y' versus L/R with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 12 degrees and a speed of 12.5 knots.

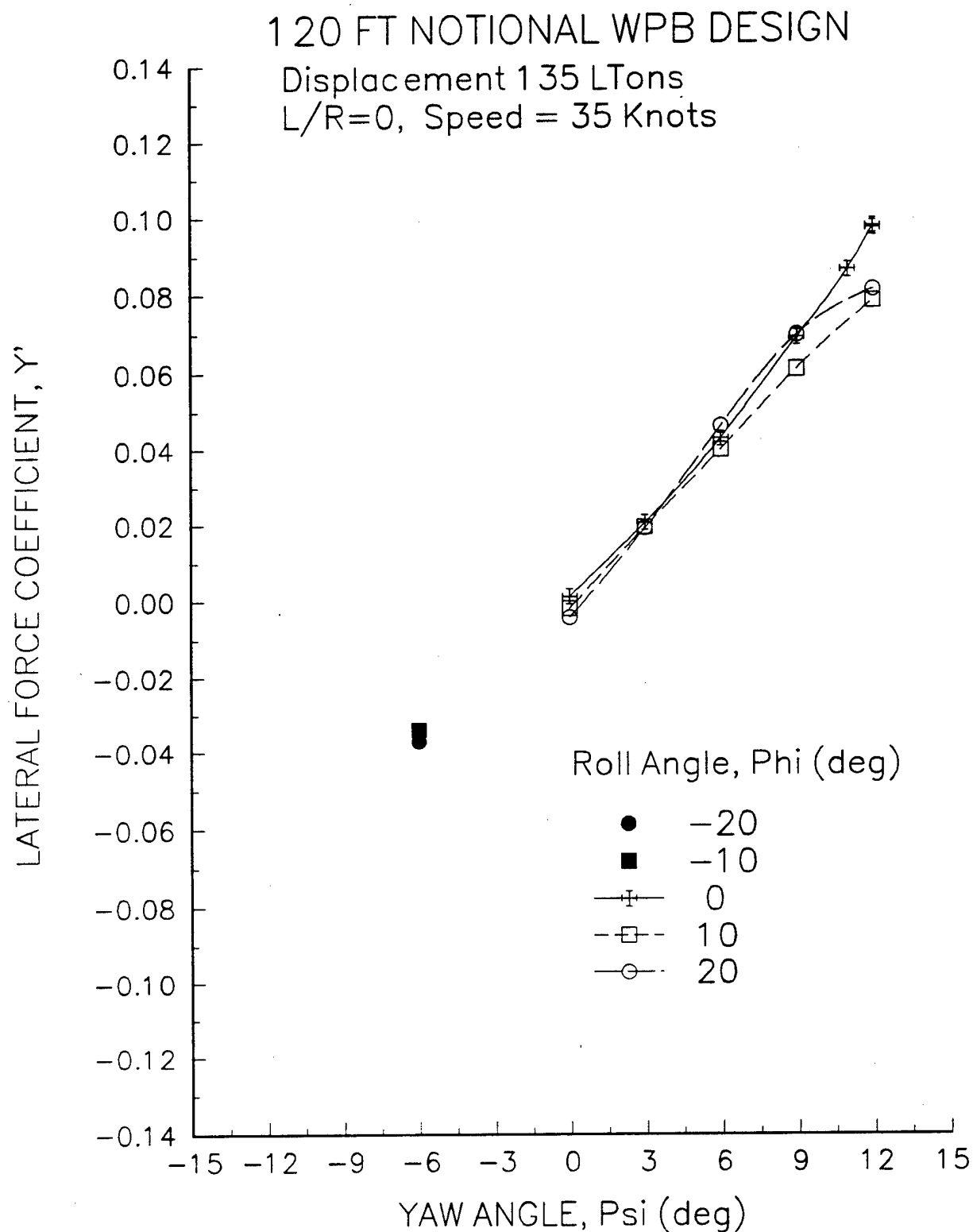


Figure D-37. Y' versus Psi with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.000 and a speed of 35 knots.

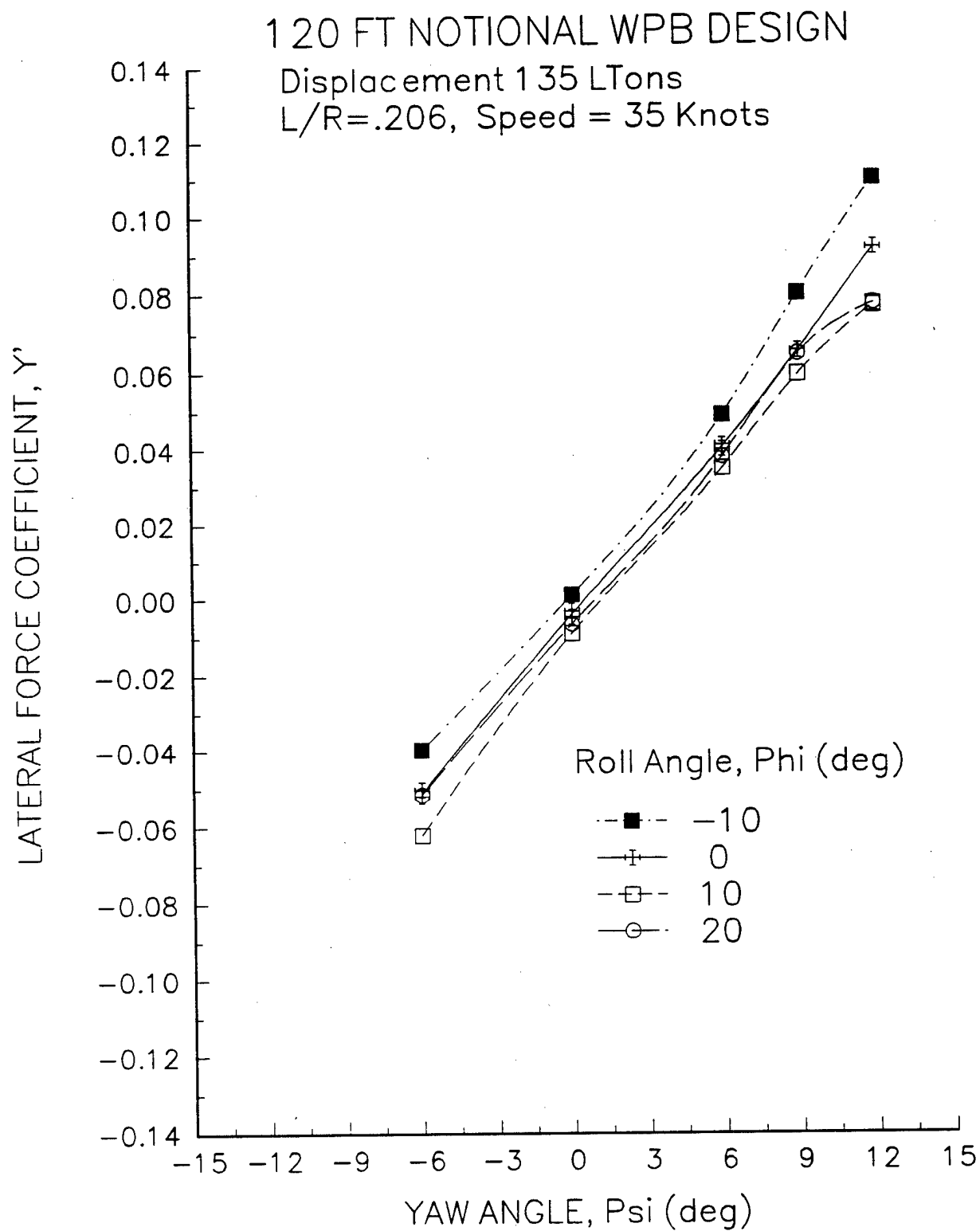


Figure D-38. Y' versus Ψ with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.206 and a speed of 35 knots.

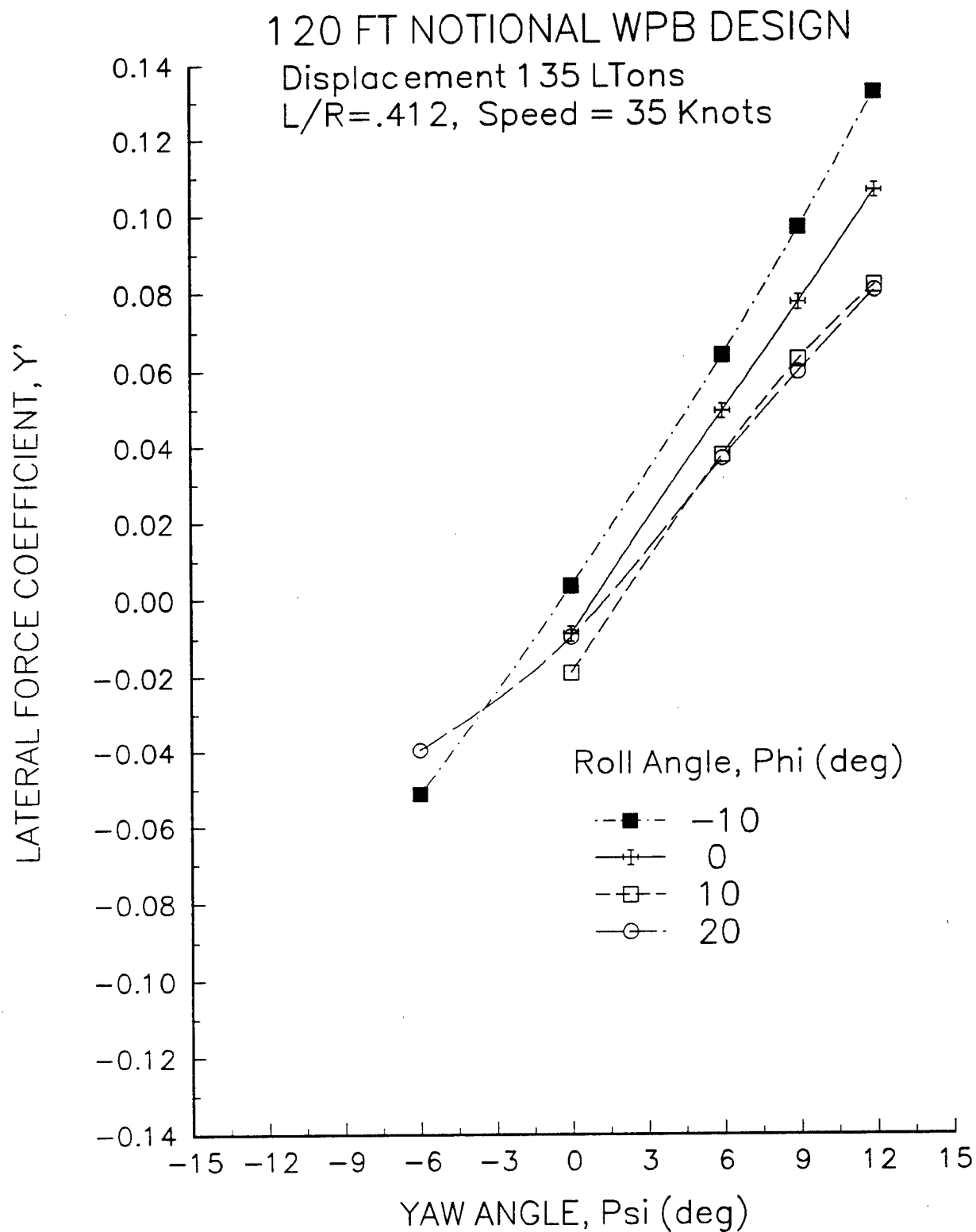


Figure D-39. Y' versus Ψ with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.412 and a speed of 35 knots.

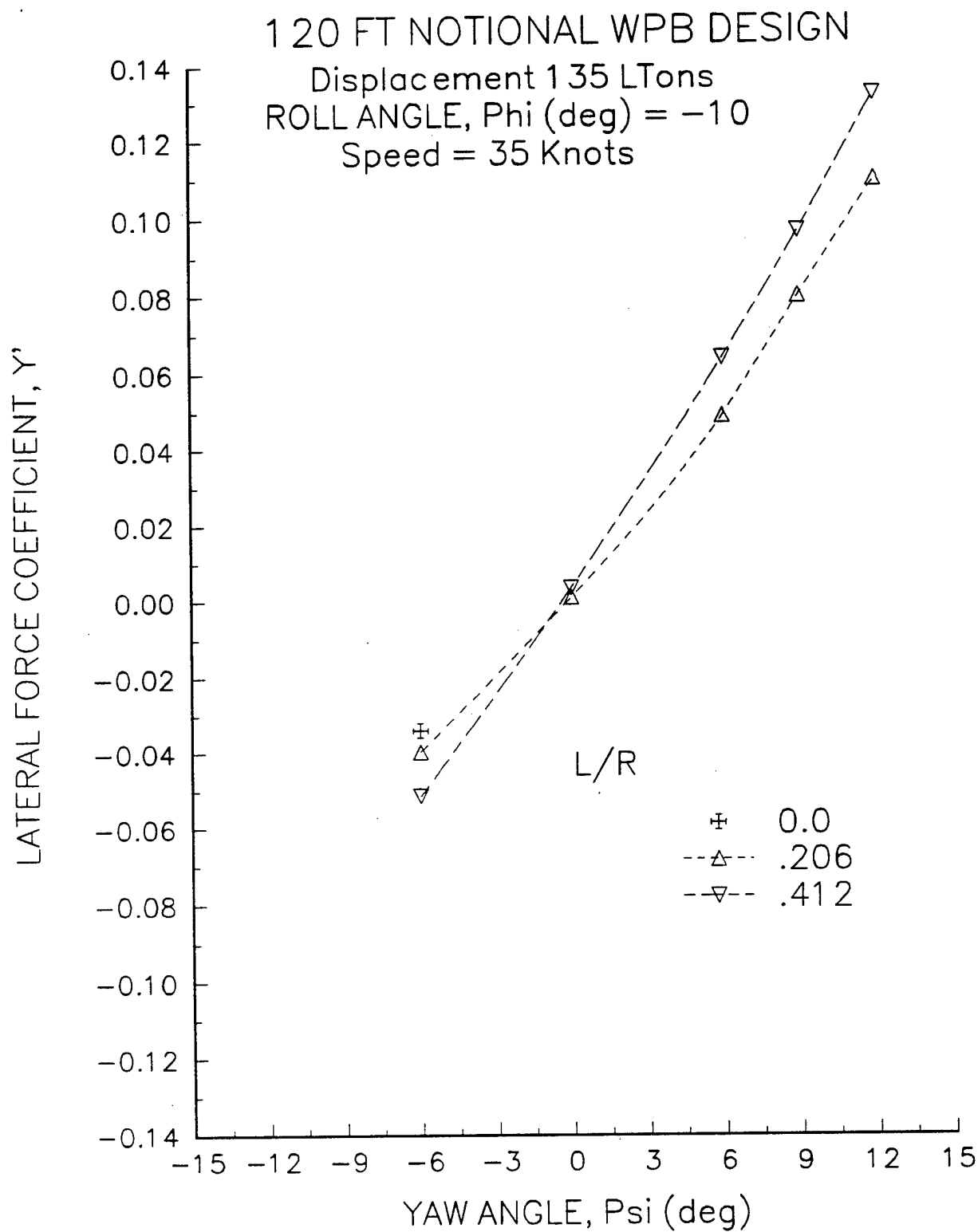


Figure D-40. Y' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of -10 degrees and a speed of 35 knots.

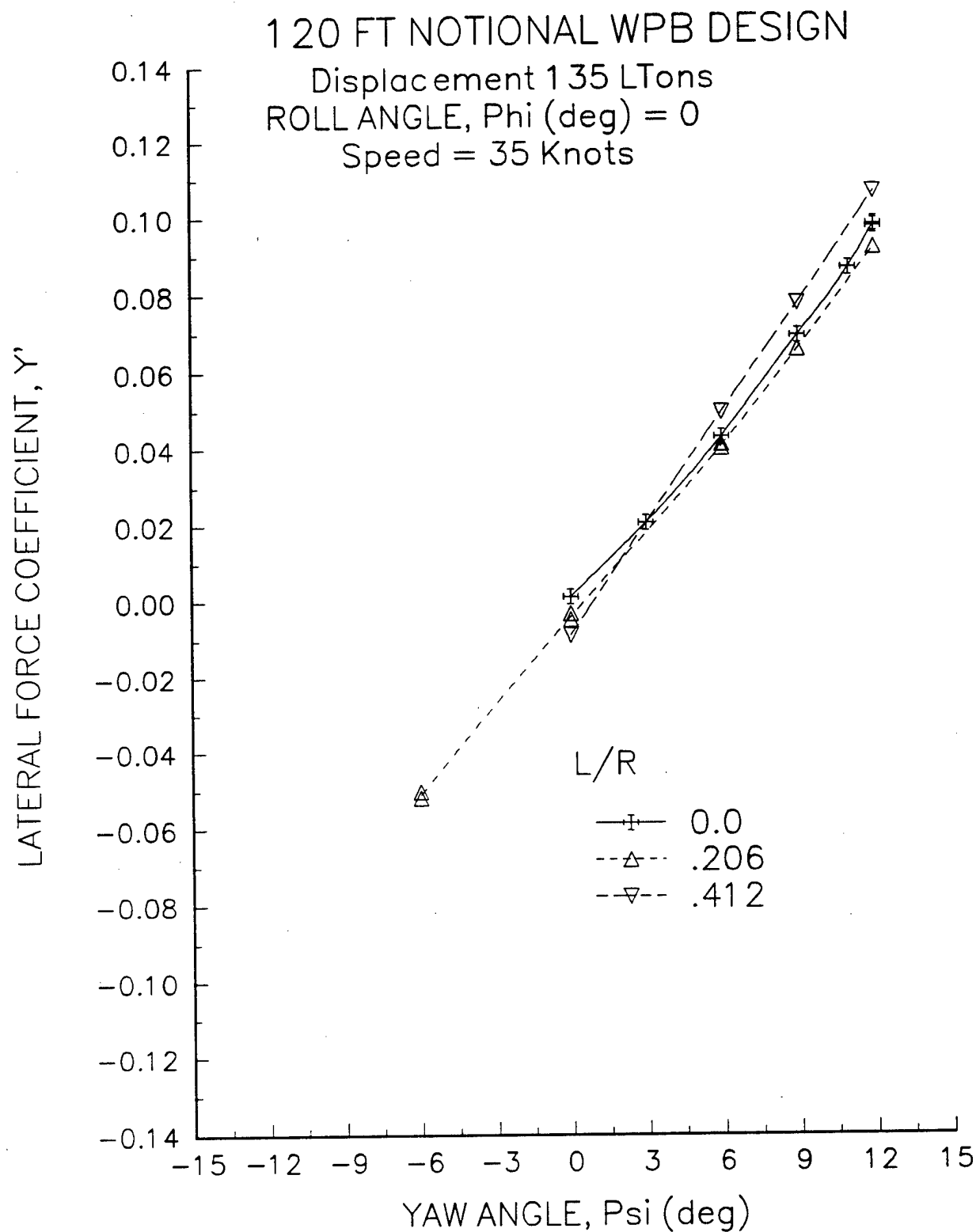


Figure D-41. Y' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 0 degrees and a speed of 35 knots.

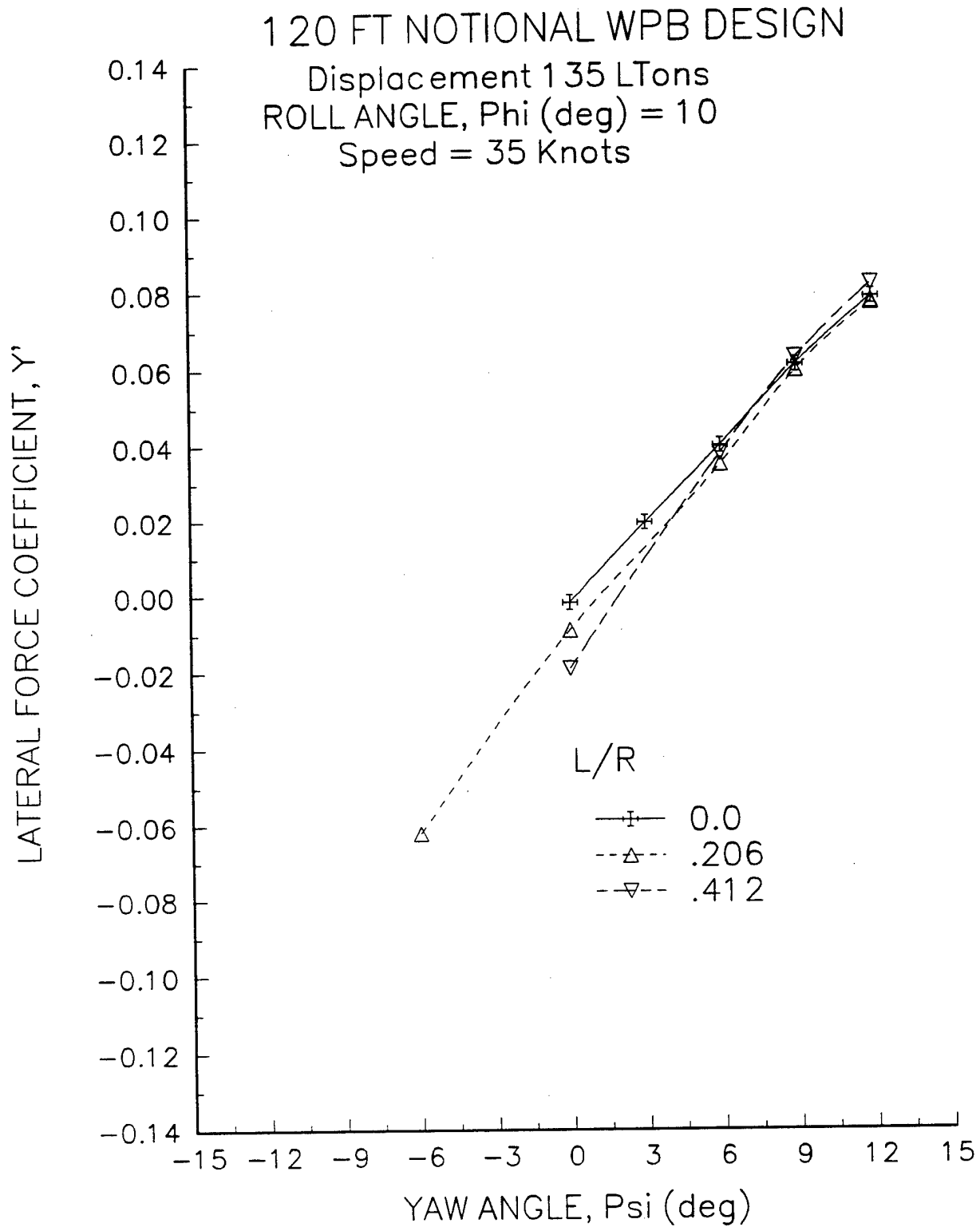


Figure D-42. Y' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 10 degrees and a speed of 35 knots.

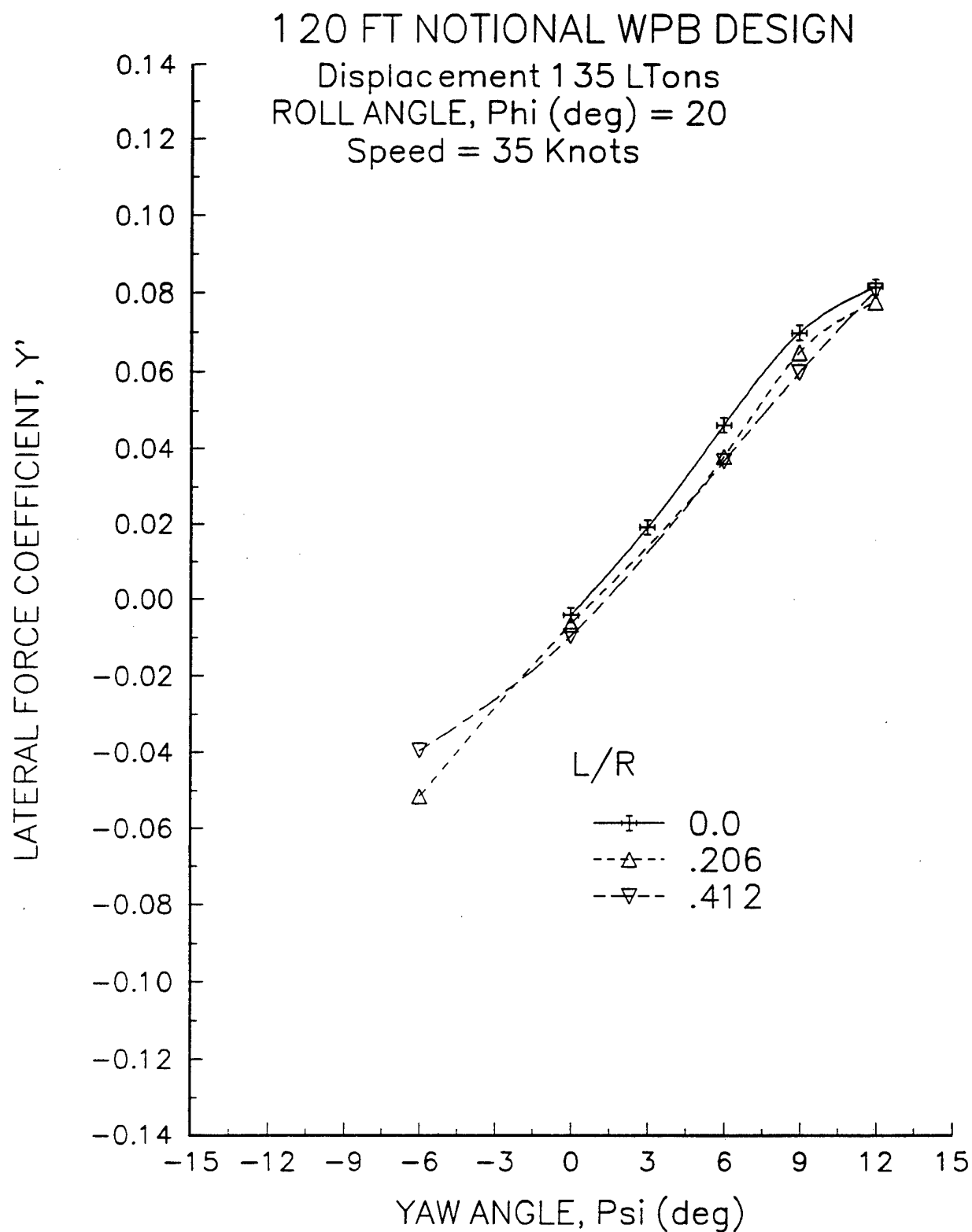


Figure D-43. Y' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 20 degrees and a speed of 35 knots.

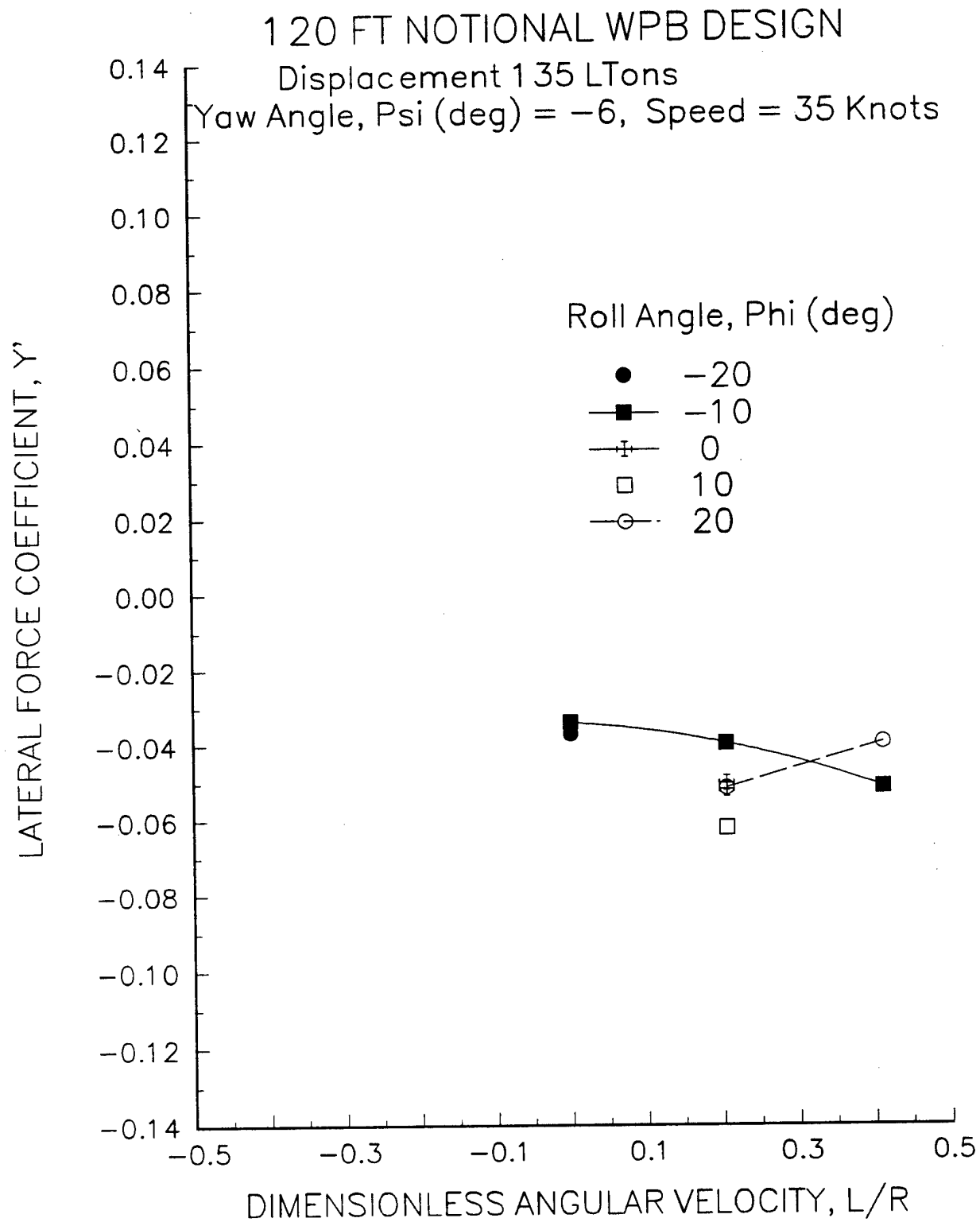


Figure D-44. Y' versus L/R with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of -6 degrees and a speed of 35 knots.

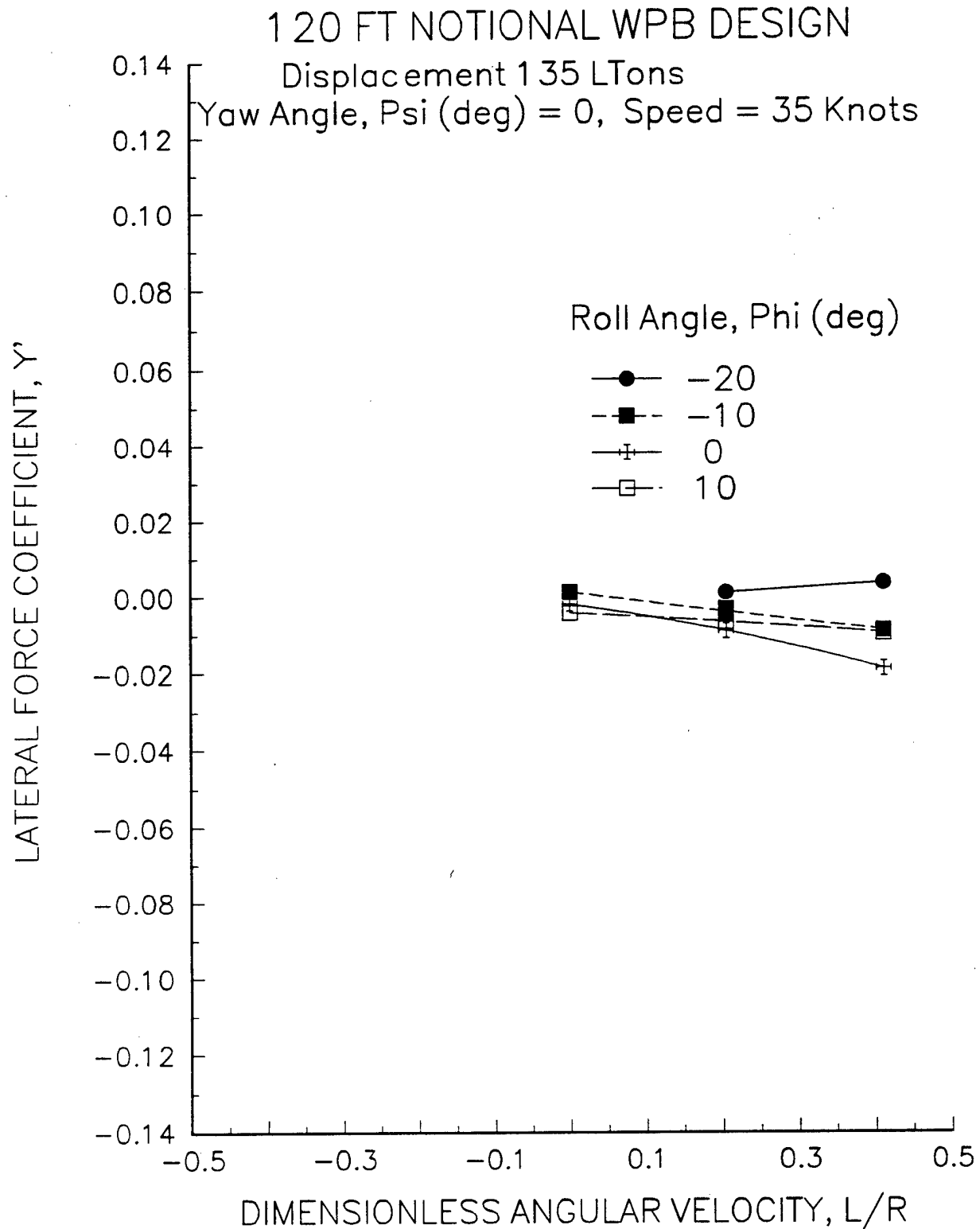


Figure D-45. Y' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 0 degrees and a speed of 35 knots.

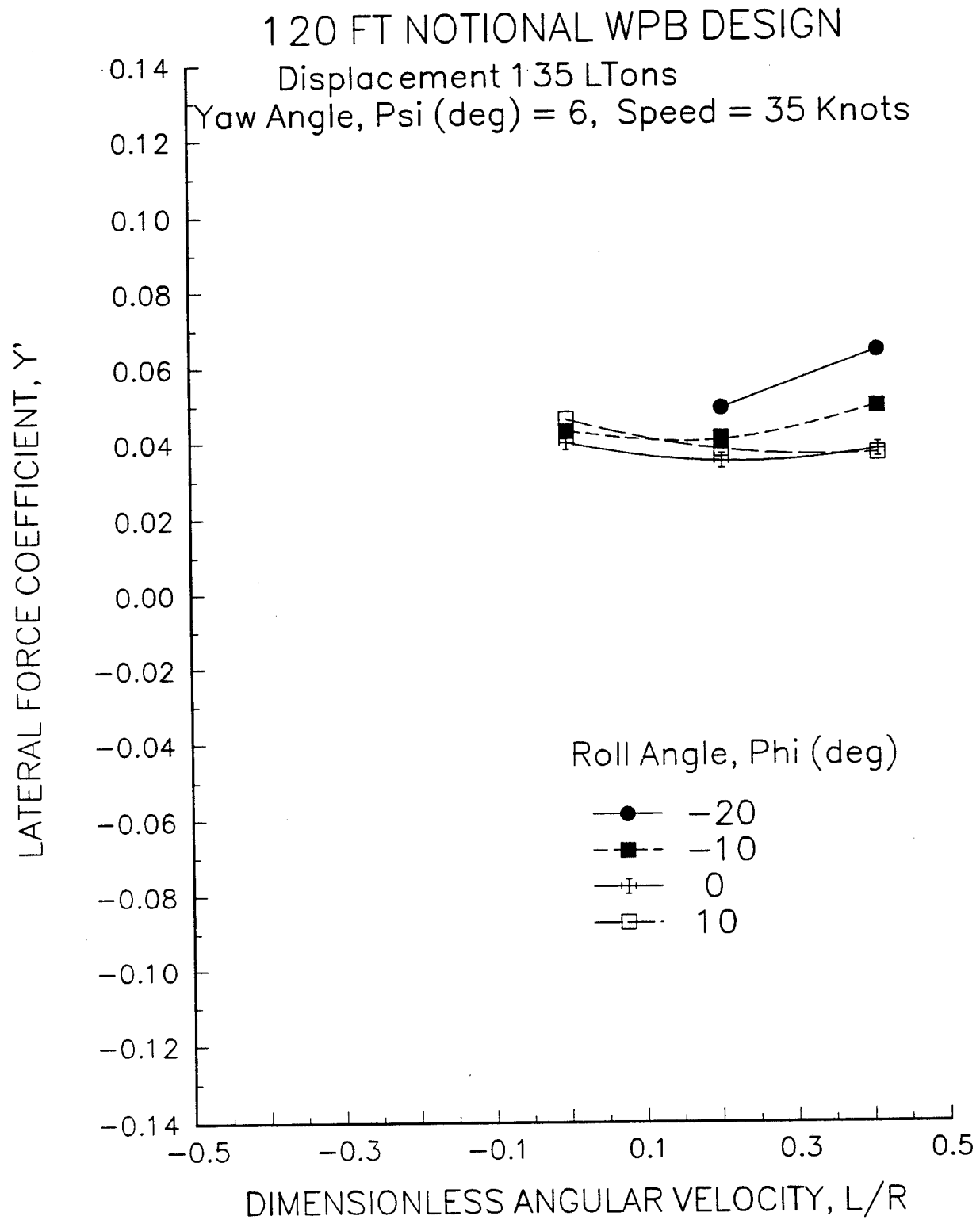


Figure D-46. Y' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 6 degrees and a speed of 35 knots.

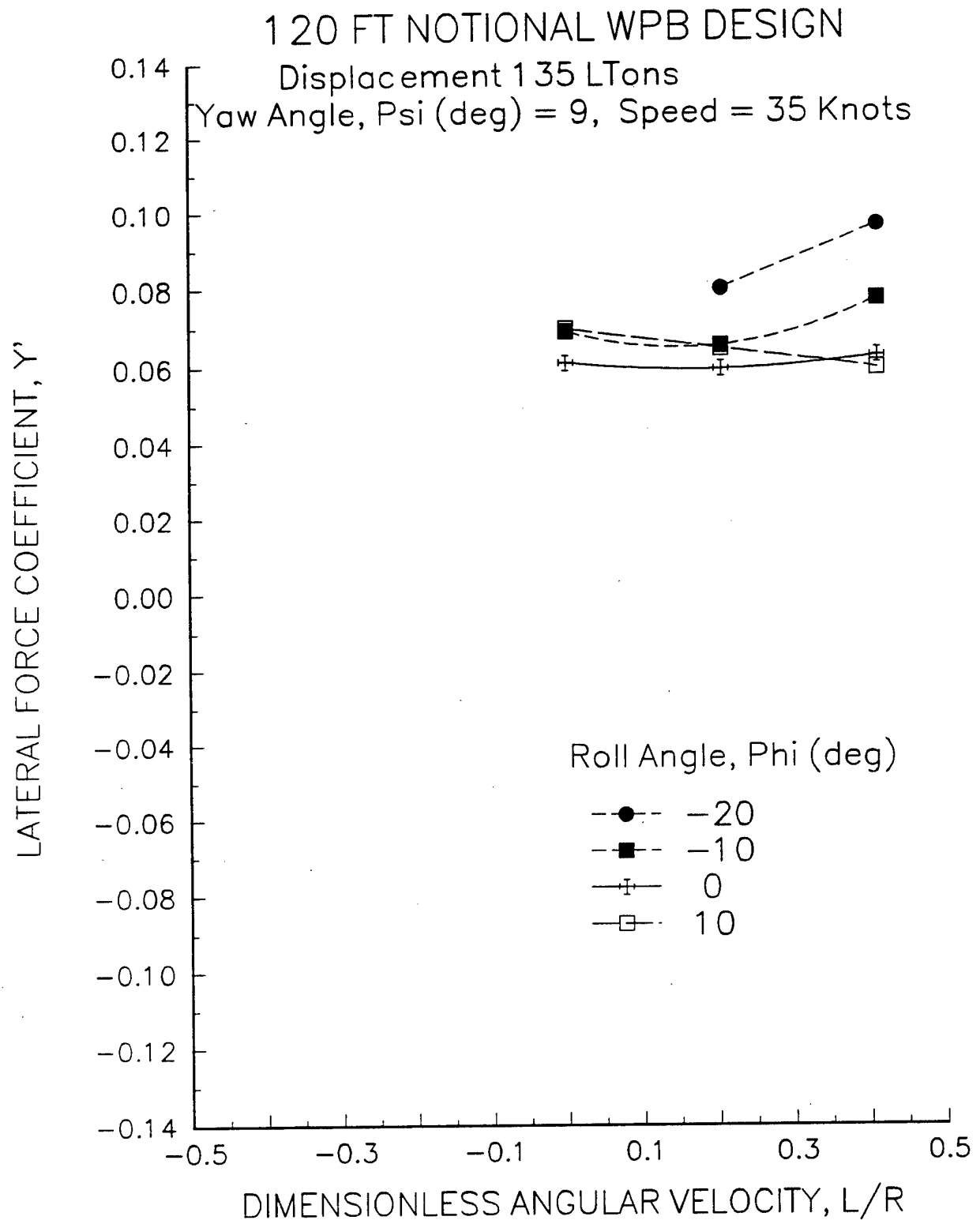


Figure D-47. Y' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 9 degrees and a speed of 35 knots.

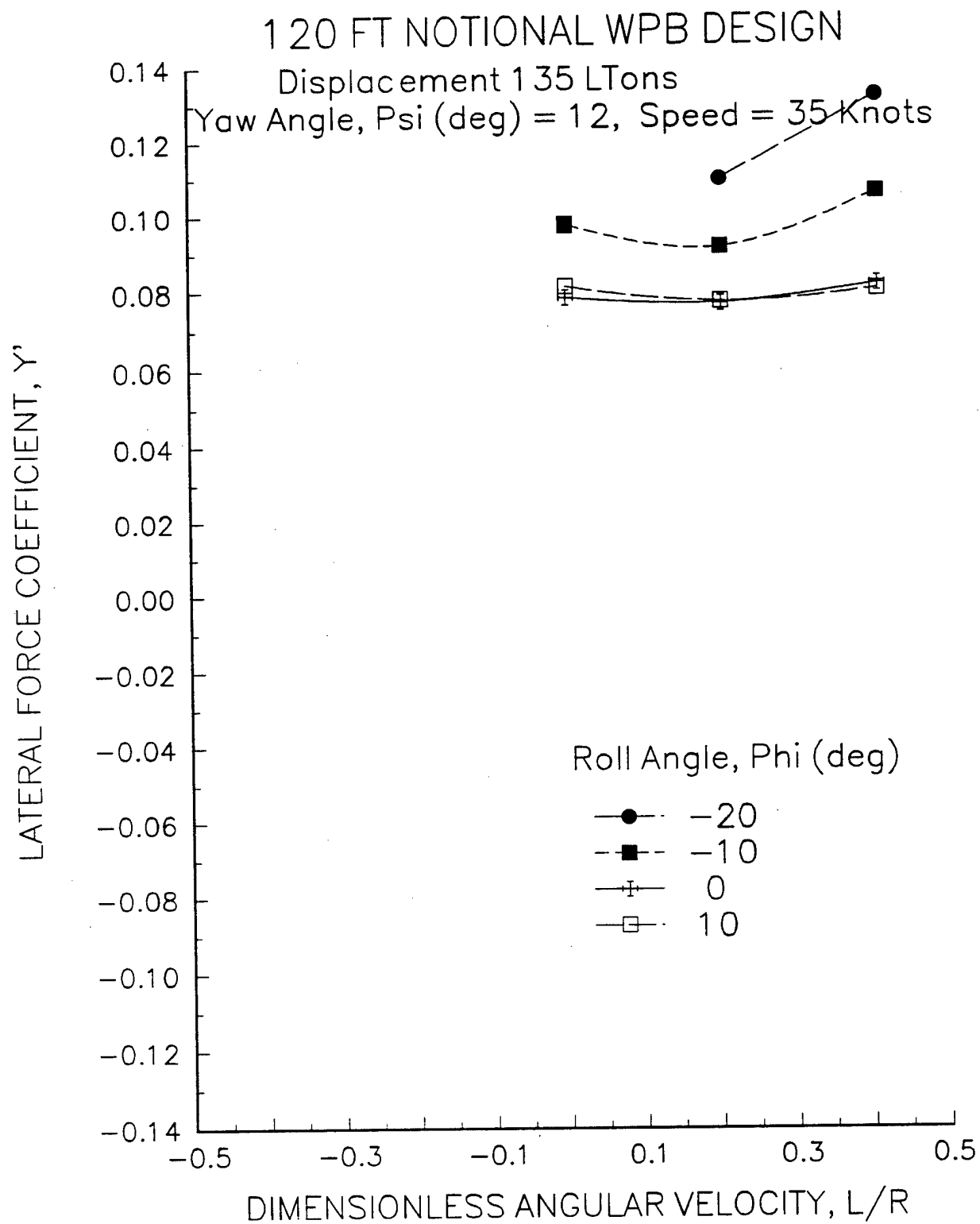


Figure D-48. Y' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 12 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

L/R=0, Speed = 12.5 Knots

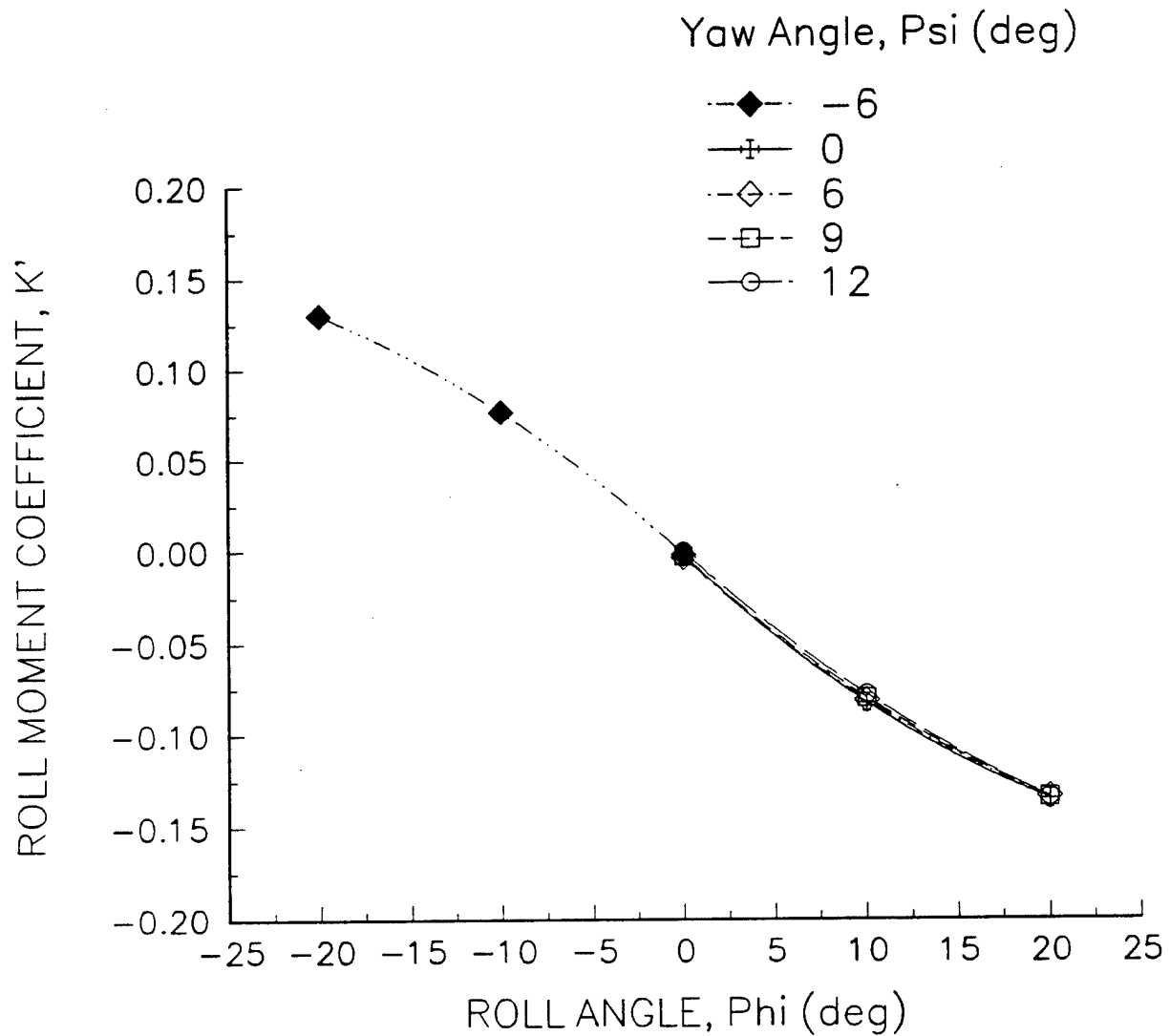


Figure D-49. K' versus Phi with Psi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.000 and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

L/R=.206, Speed = 12.5 Knots

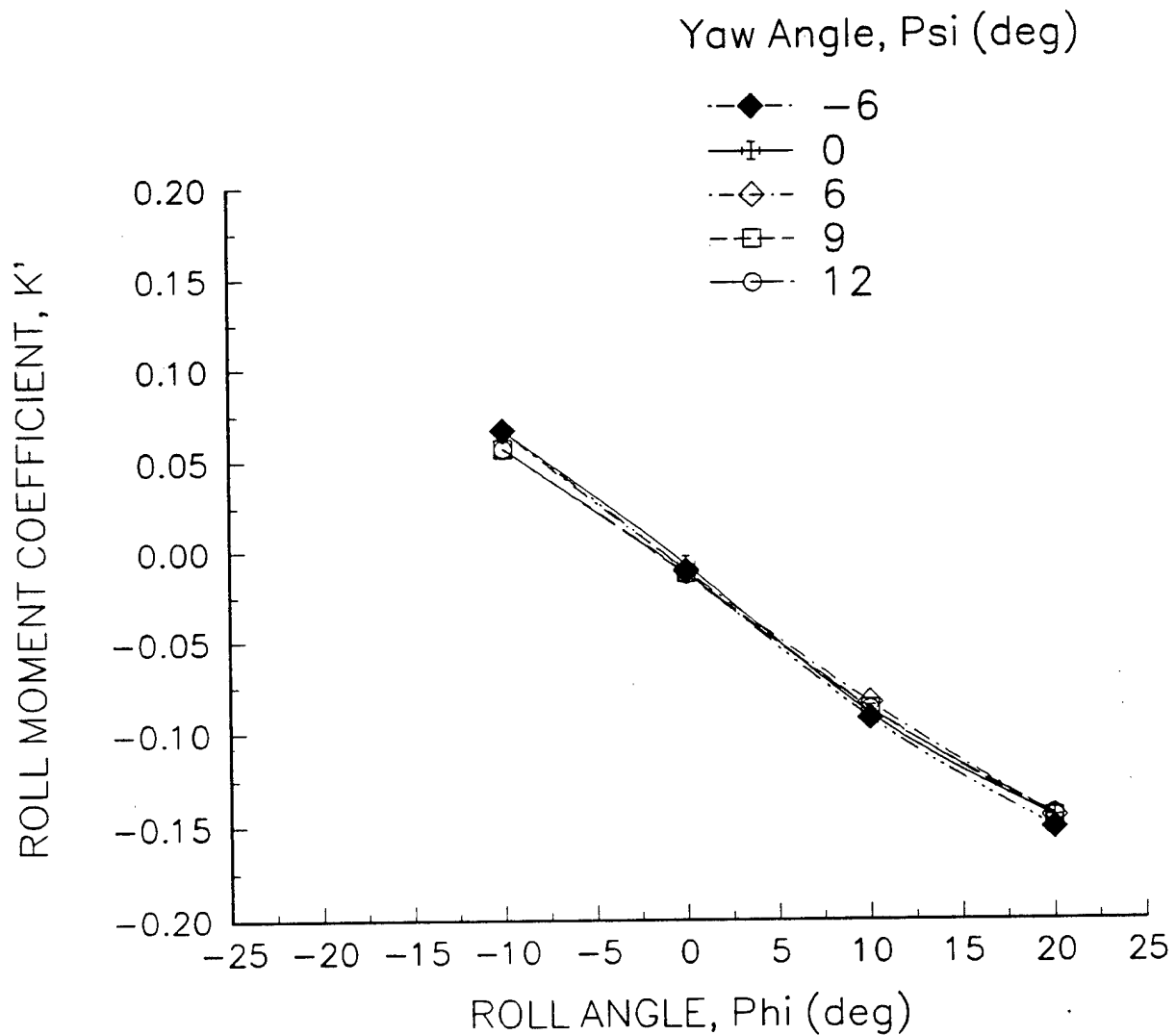


Figure D-50. K' versus Phi with Psi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.206 and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 L.Tons

$L/R = .412$, Speed = 12.5 Knots

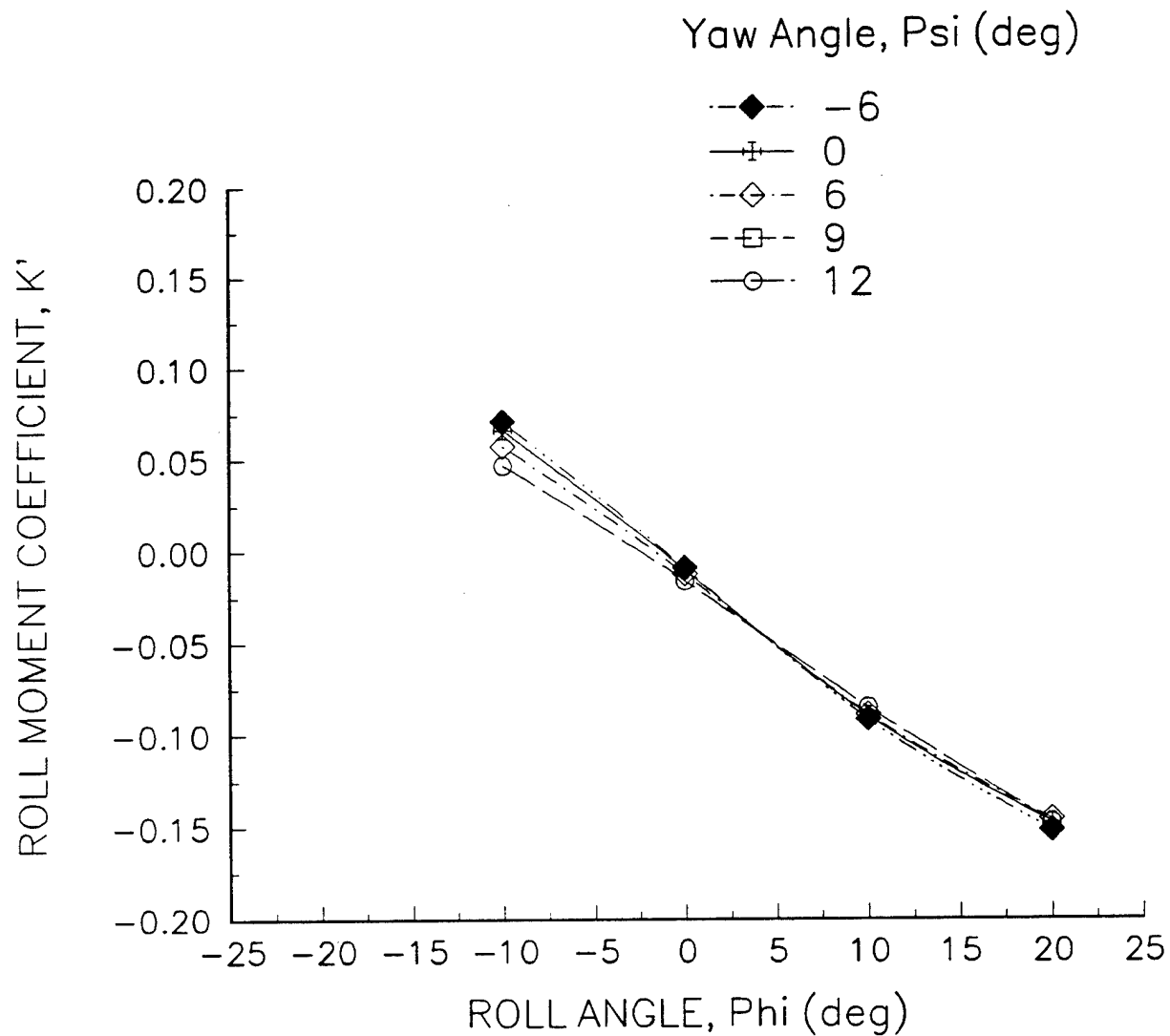


Figure D-51. K' versus Phi with Psi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.412 and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN
Displacement 135 LTons
Yaw Angle, Psi = -6, Speed = 12.5 Knots

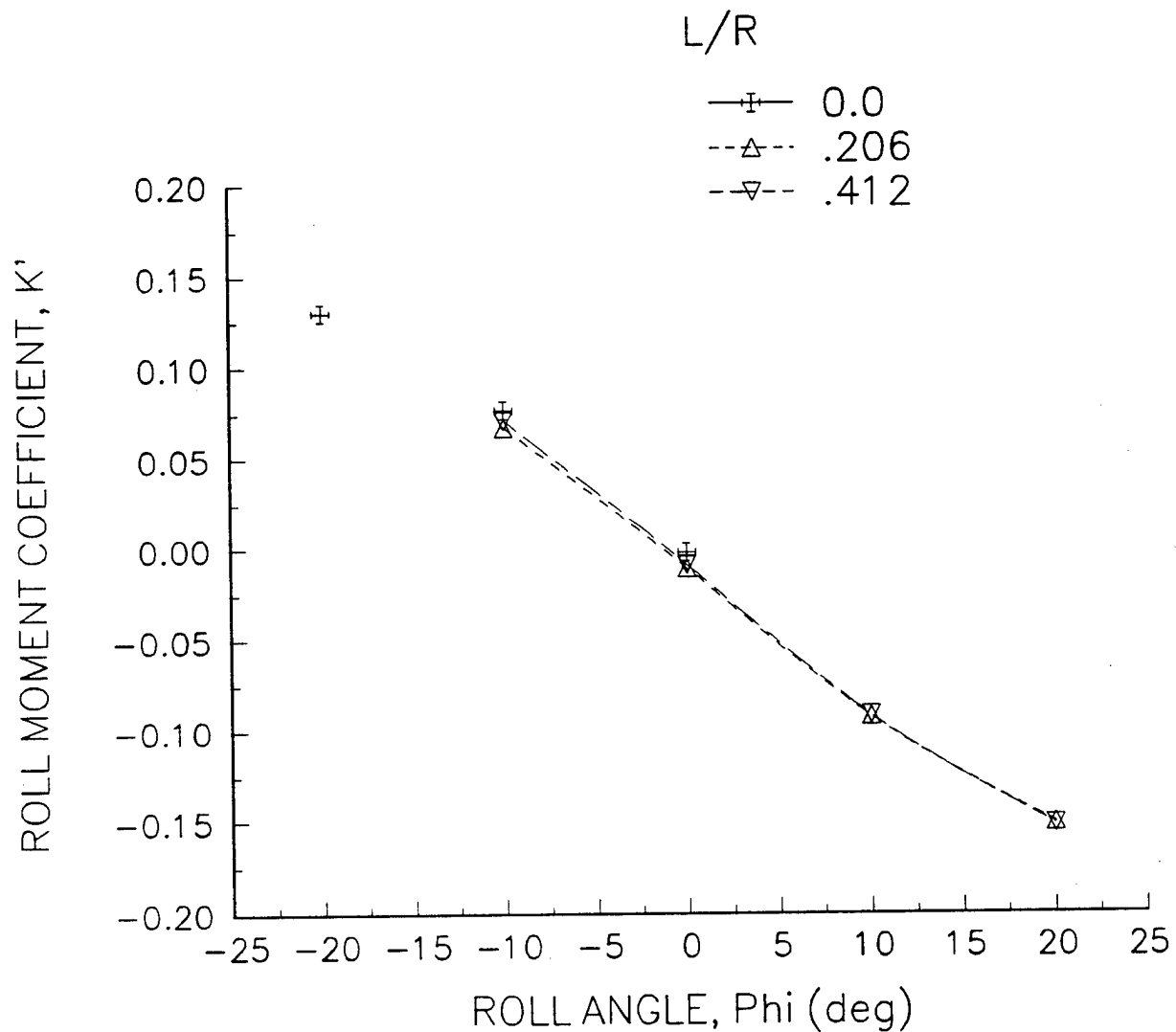


Figure D-52. K' versus Phi with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of -6 degrees and a speed of 12.5 knots.

1 20 FT NOTIONAL WPB DESIGN
Displacement 1 35 LTons
Yaw Angle, $\Psi = 0$, Speed = 12.5 Knots

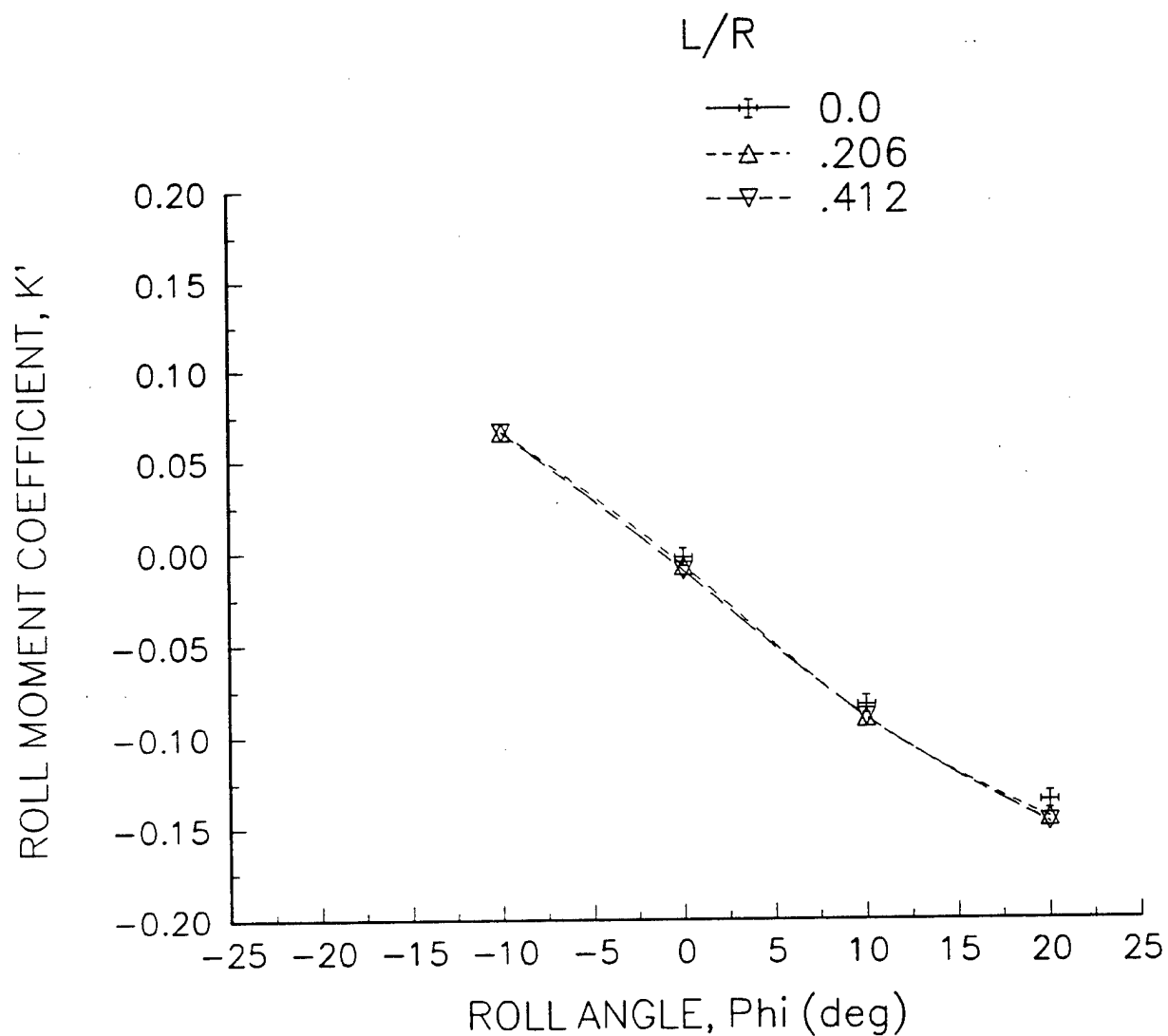


Figure D-53. K' versus Φ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Ψ of 0 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN
Displacement 135 LTons
Yaw Angle, $\Psi = 6$, Speed = 12.5 Knots

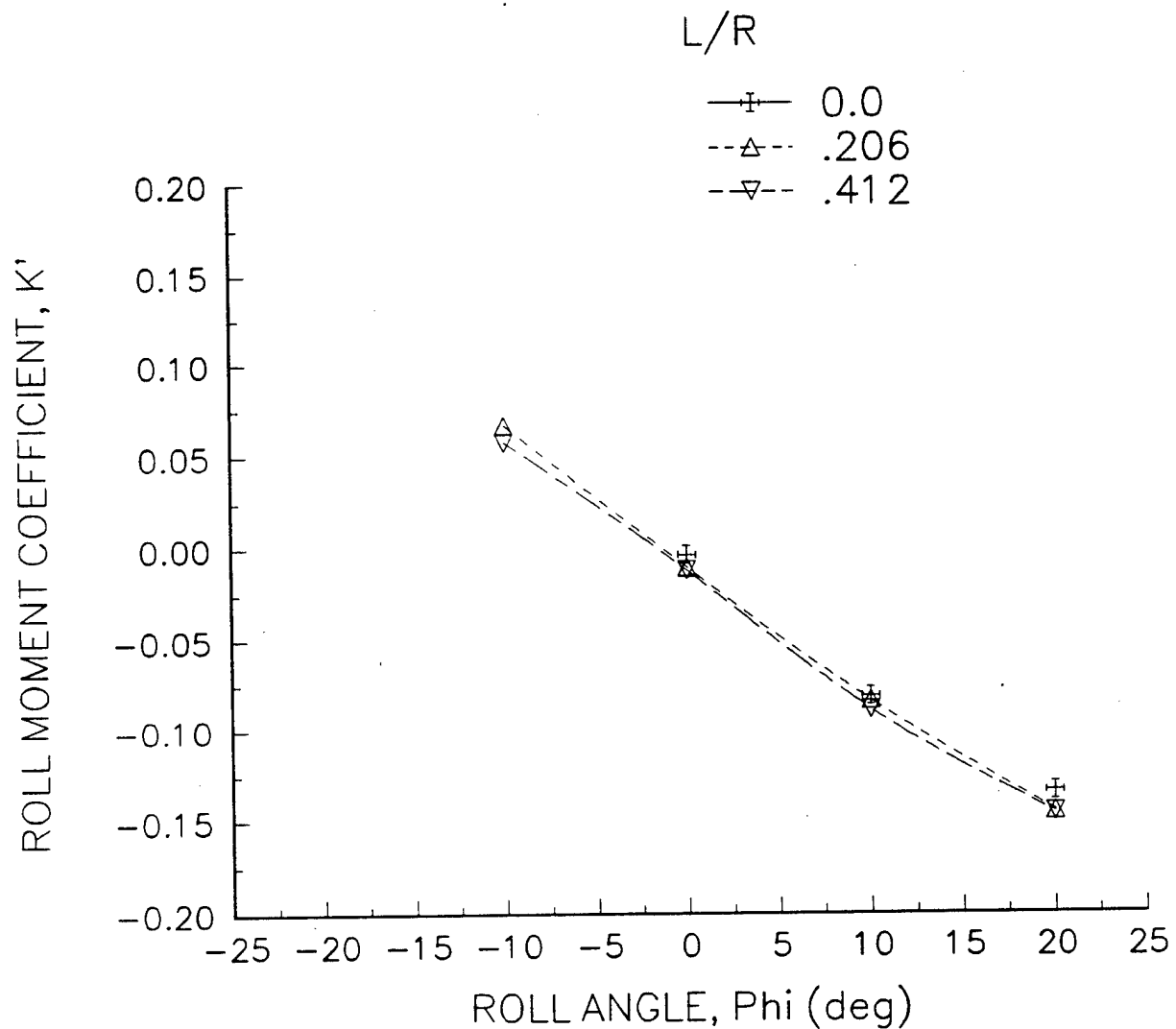


Figure D-54. K' versus Φ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Ψ of 6 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN
Displacement 135 LTons
Yaw Angle, $\Psi = 9$, Speed = 12.5 Knots

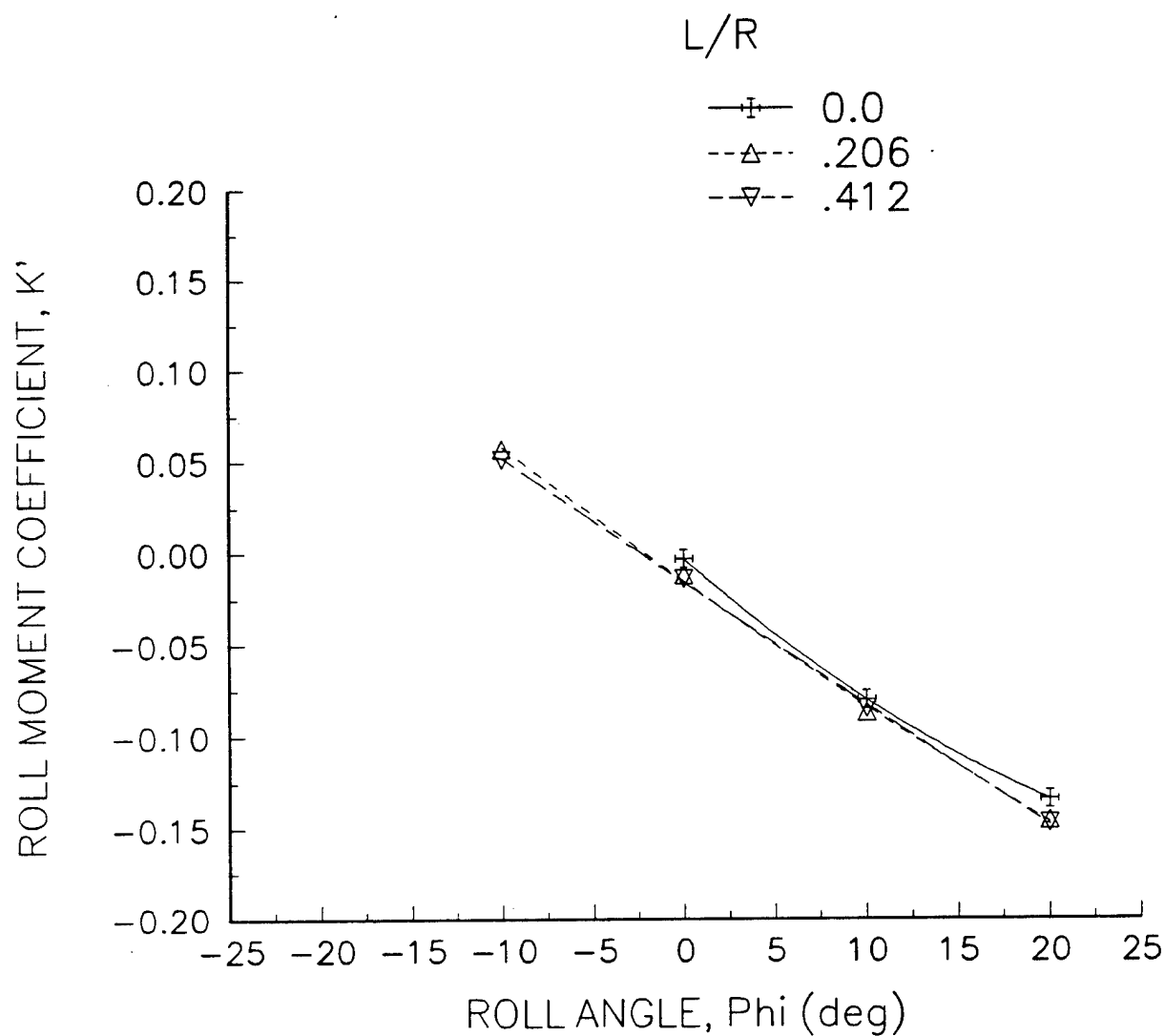


Figure D-55. K' versus Φ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Ψ of 9 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN
Displacement 135 LTons
Yaw Angle, $\Psi = 12$, Speed = 12.5 Knots

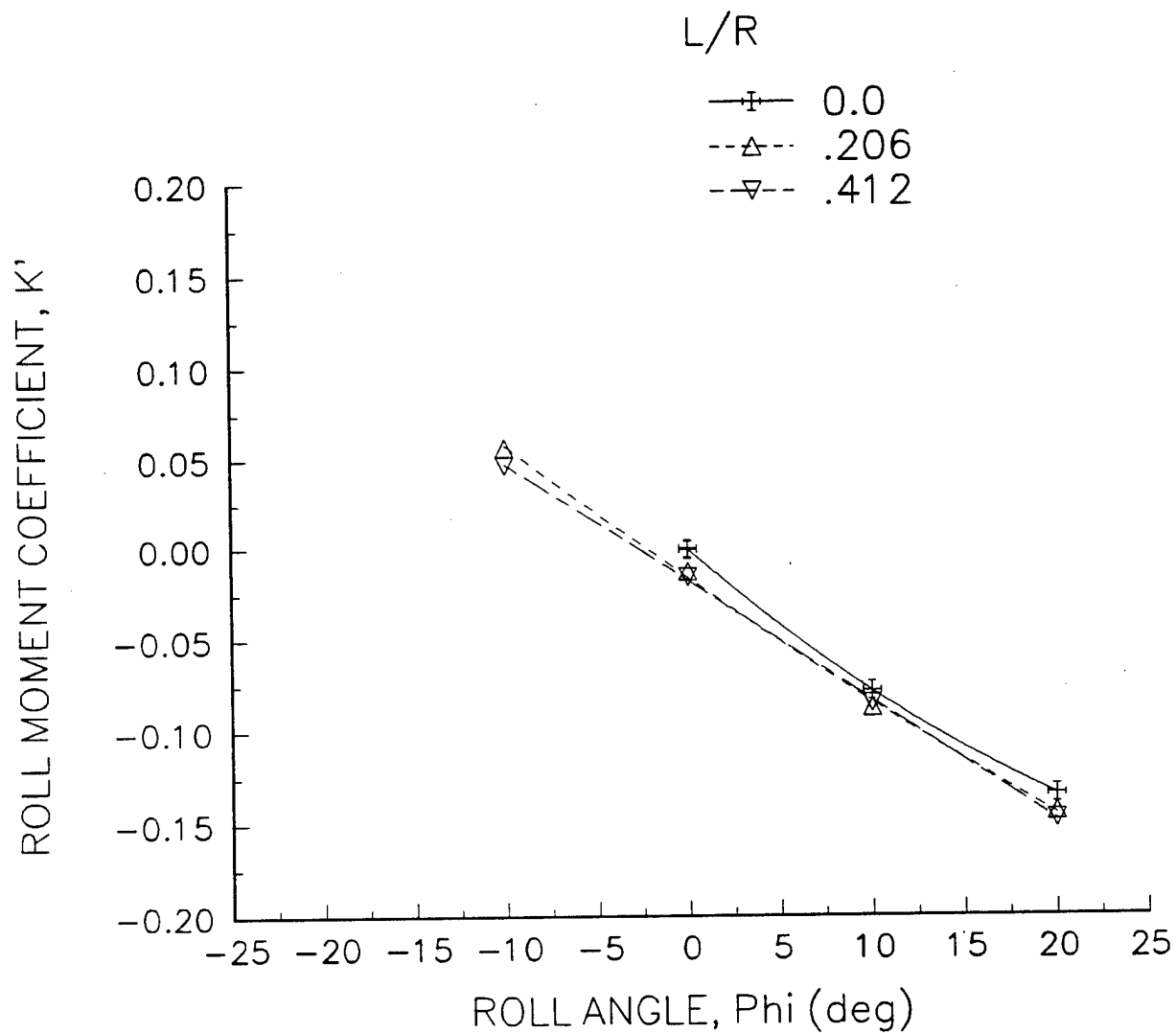


Figure D-56. K' versus Φ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Ψ of 12 degrees and a speed of 12.5 knots.

1 20 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Roll Angle, Φ (deg) = -10, Speed = 12.5 Knots

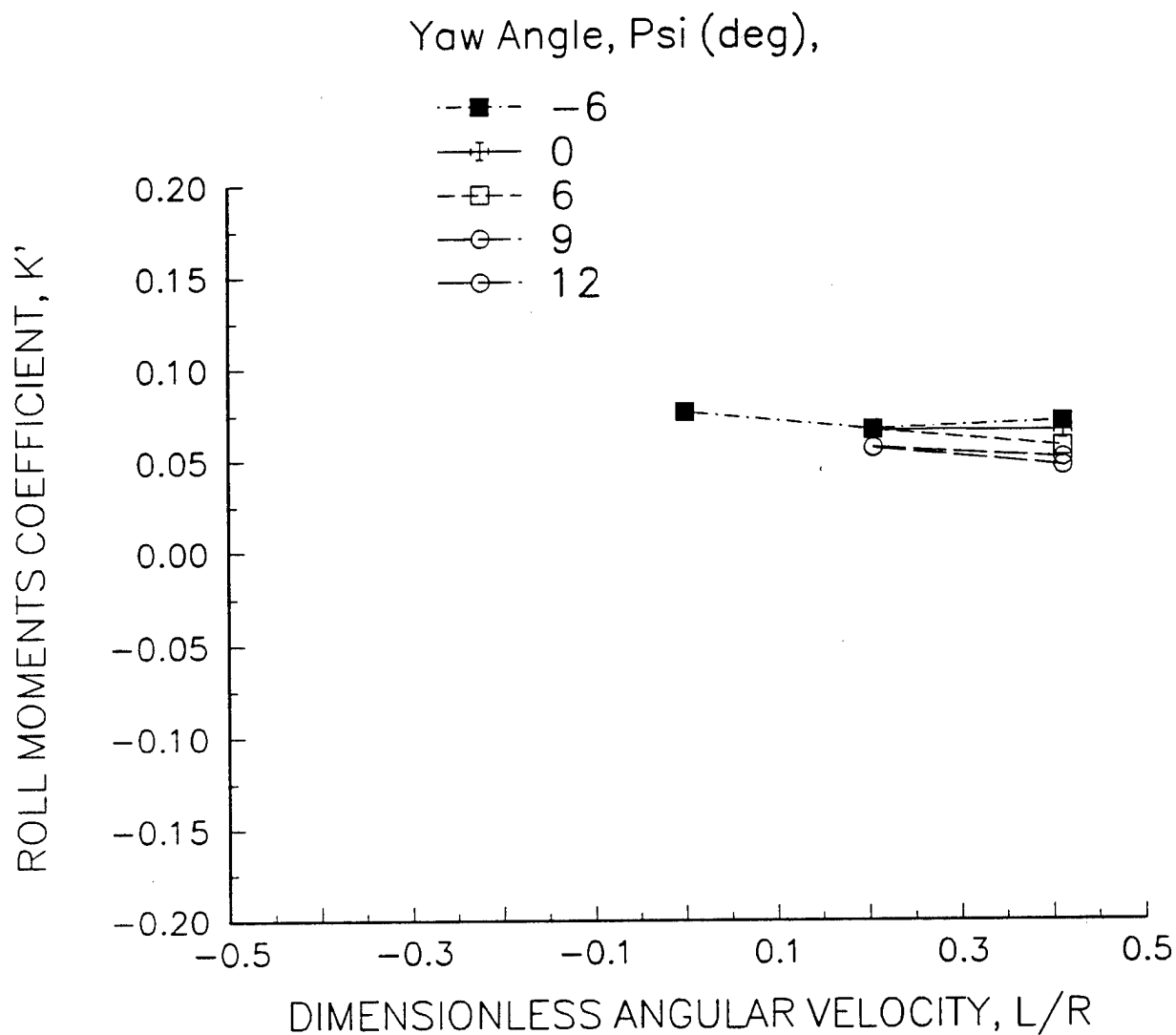


Figure D-57. K' versus L/R with Ψ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of -10 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Roll Angle, Φ (deg) = 0, Speed = 12.5 Knots

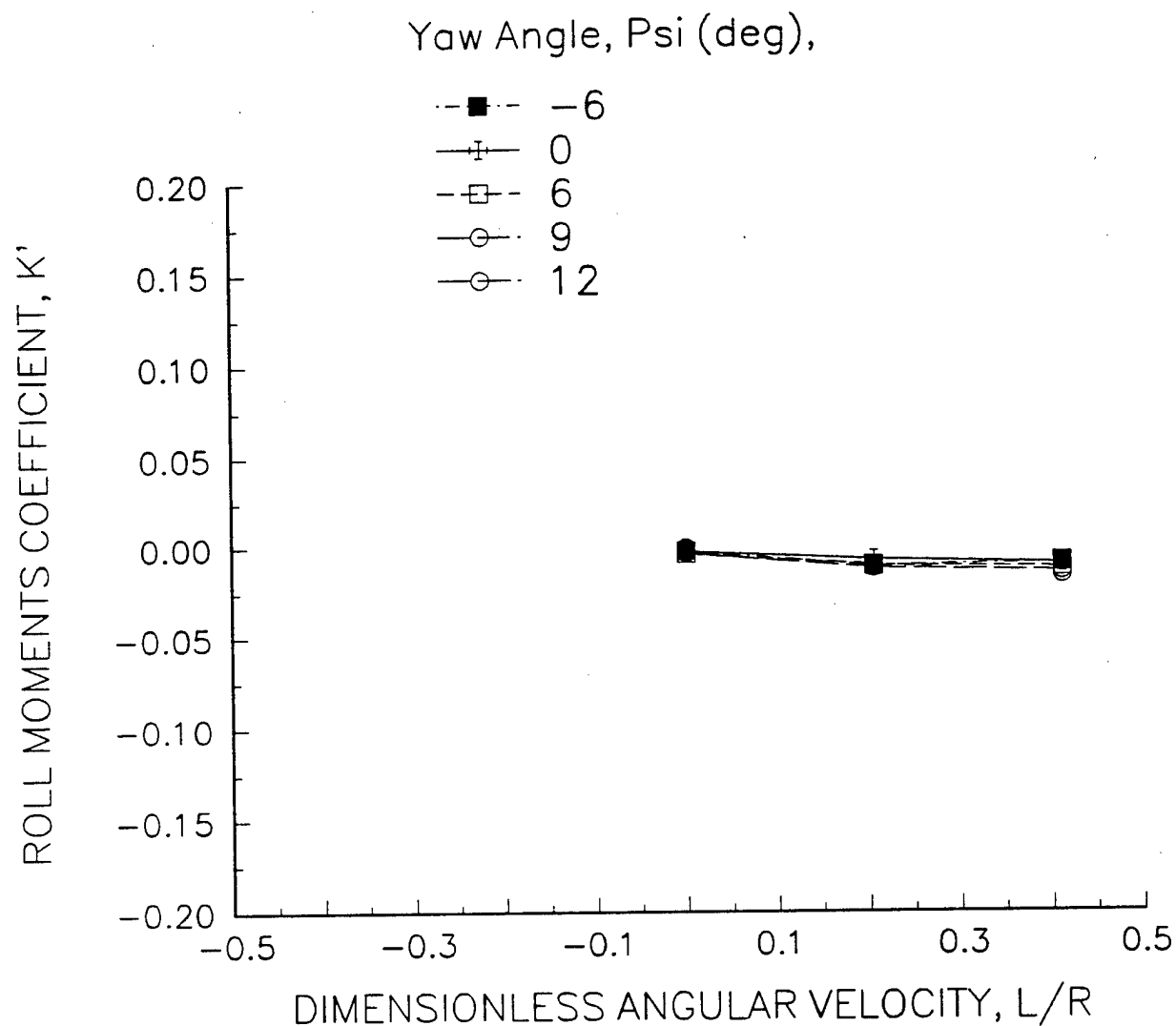


Figure D-58. K' versus L/R with Ψ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 0 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Roll Angle, Φ (deg) = 10, Speed = 12.5 Knots

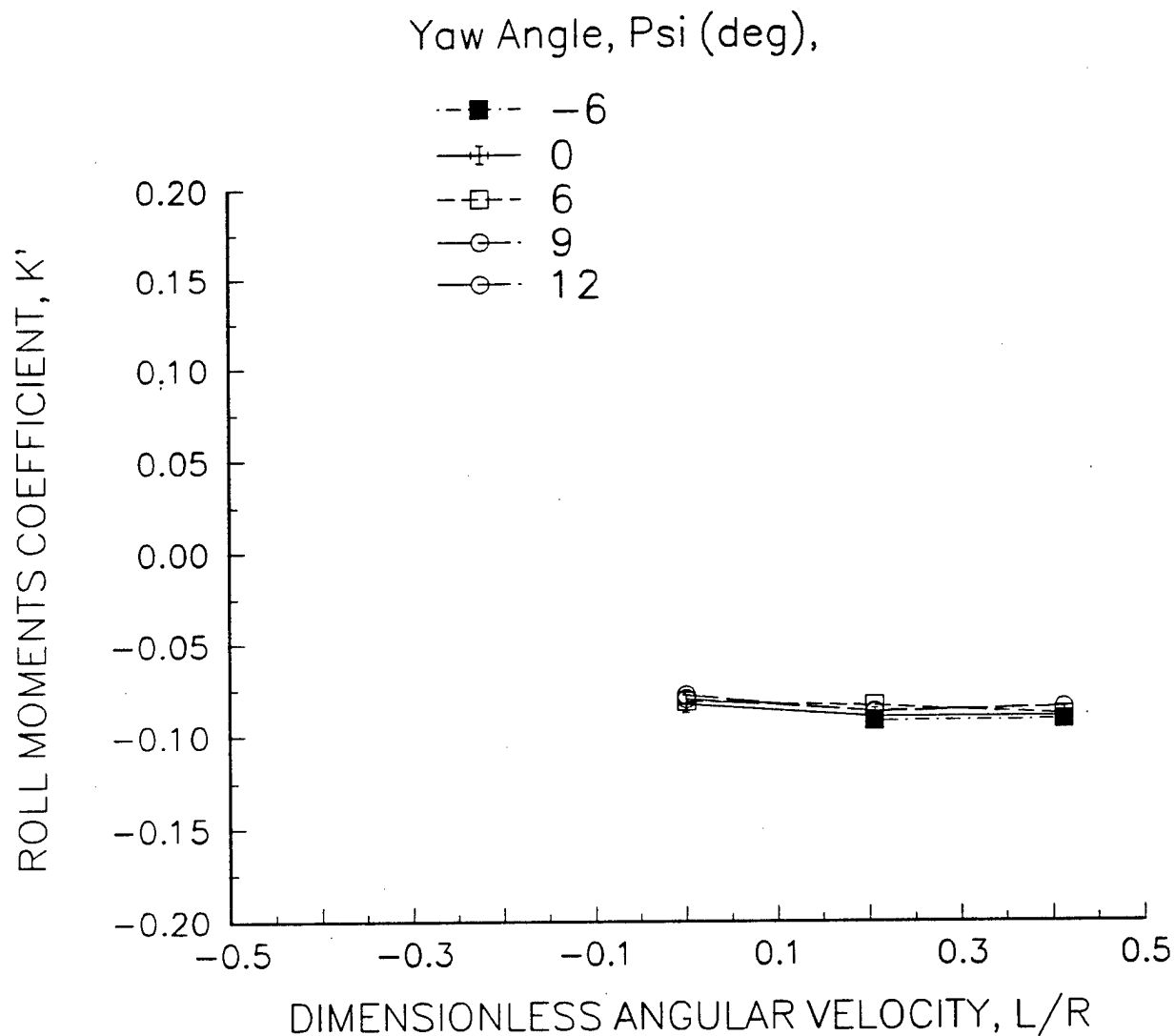


Figure D-59. K' versus L/R with Ψ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 10 degrees and a speed of 12.5 knots.

1 20 FT NOTIONAL WPB DESIGN

Displacement 1 35 LTons

Roll Angle, Φ (deg) = 20, Speed = 12.5 Knots

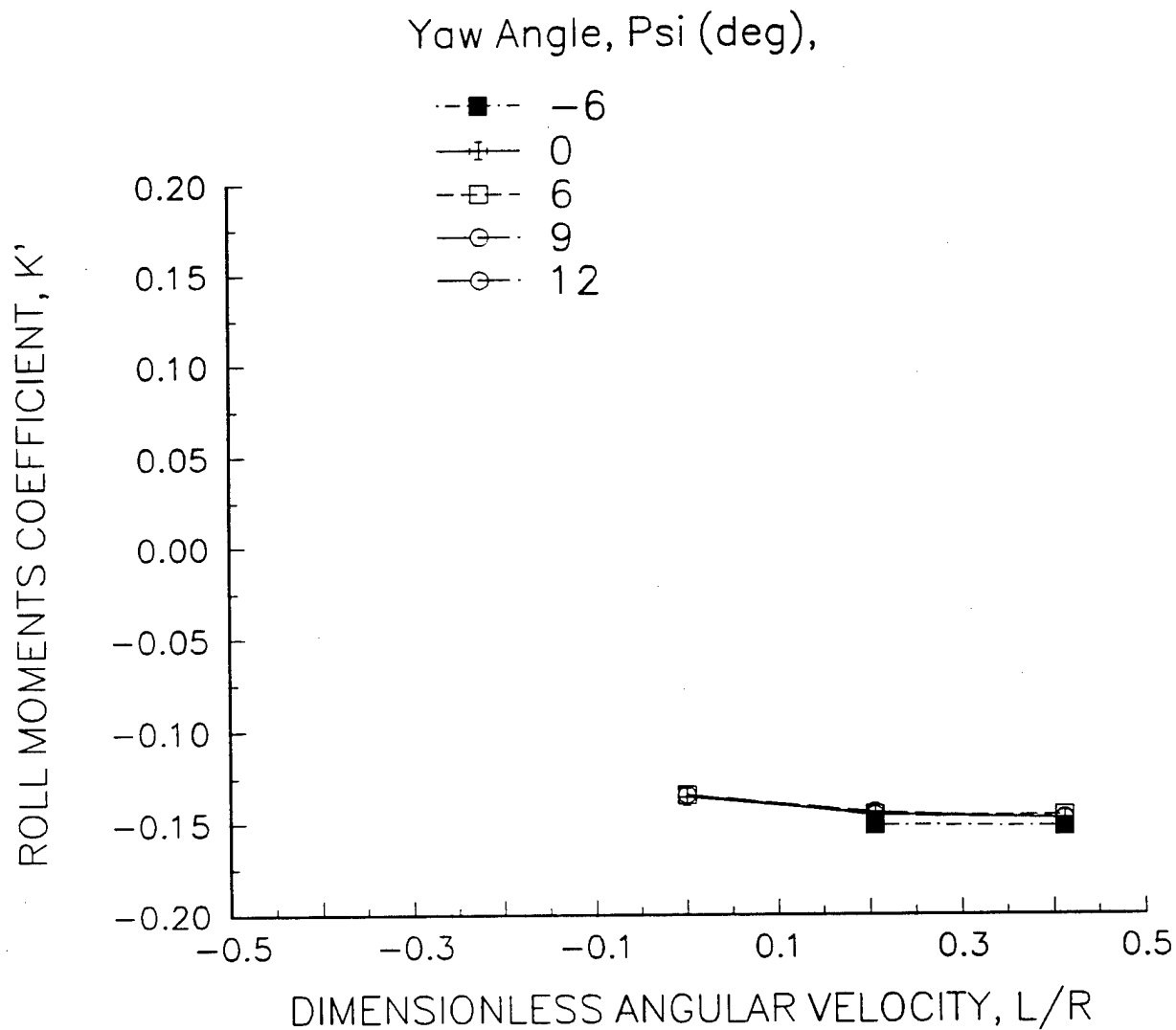


Figure D-60. K' versus L/R with Ψ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 20 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

L/R=0, Speed = 35 Knots

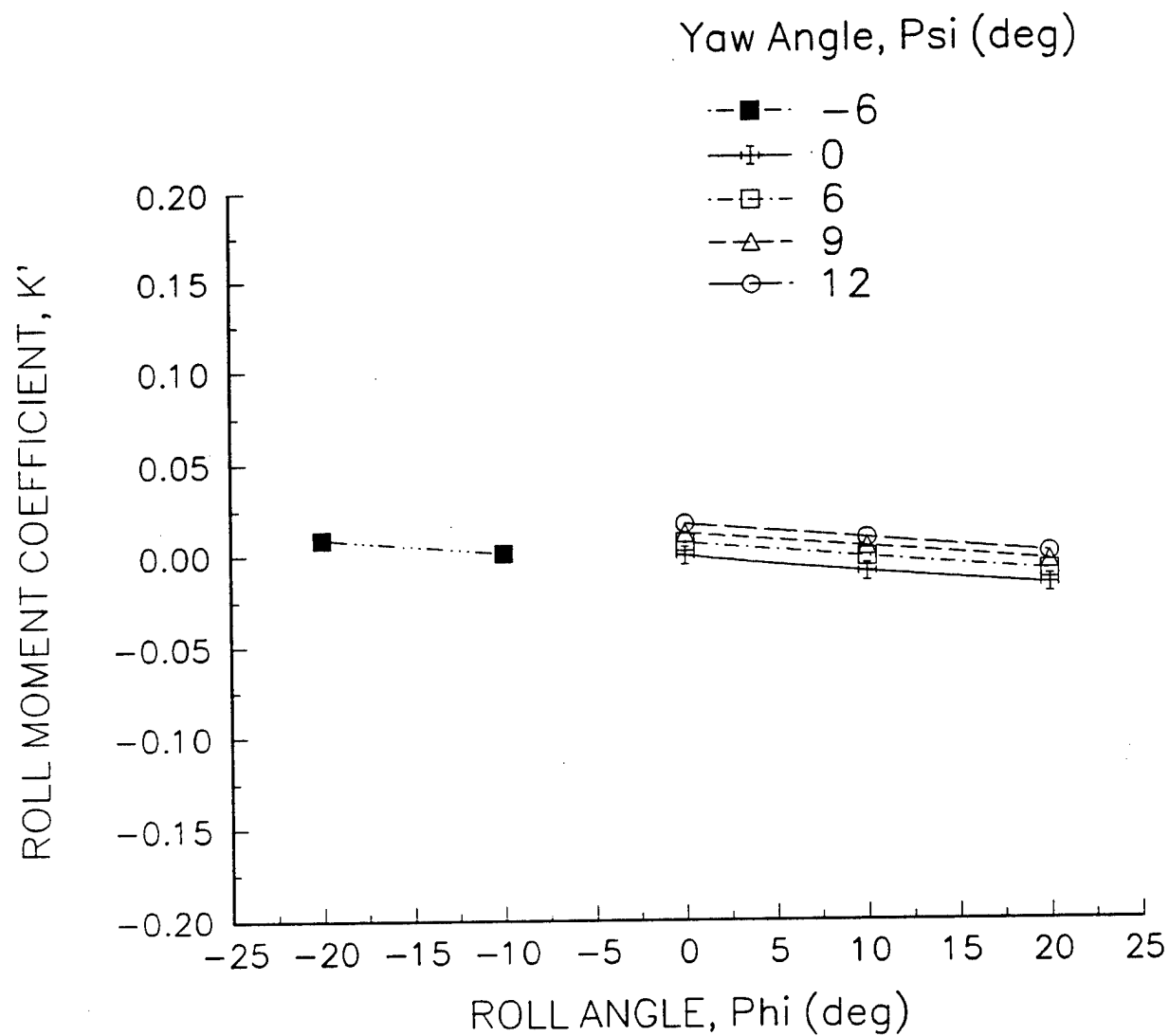


Figure D-61. K' versus Phi with Psi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.000 and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

L/R=.206, Speed = 35 Knots

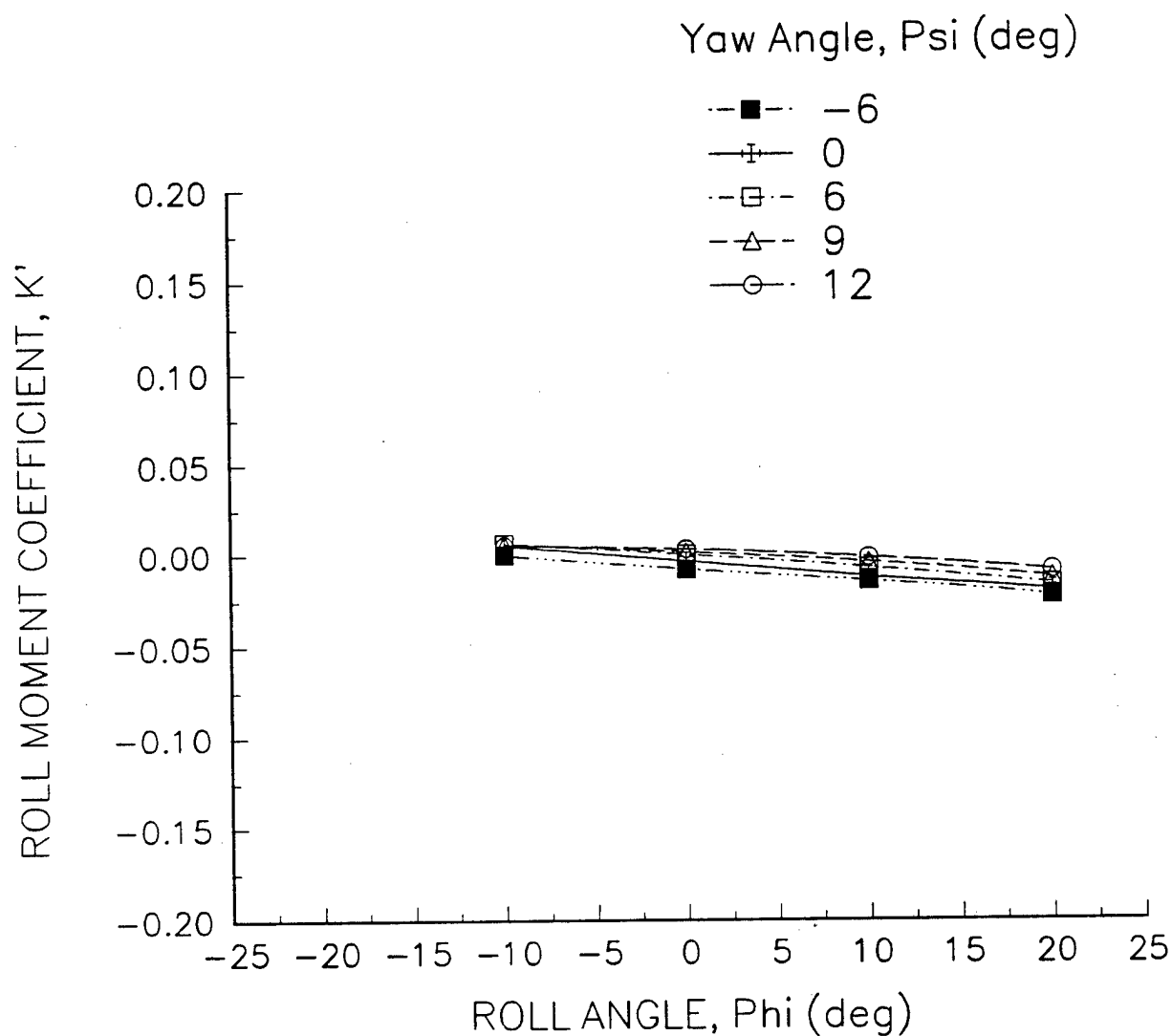


Figure D-62. K' versus Phi with Psi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.206 and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

L/R=.412, Speed = 35 Knots

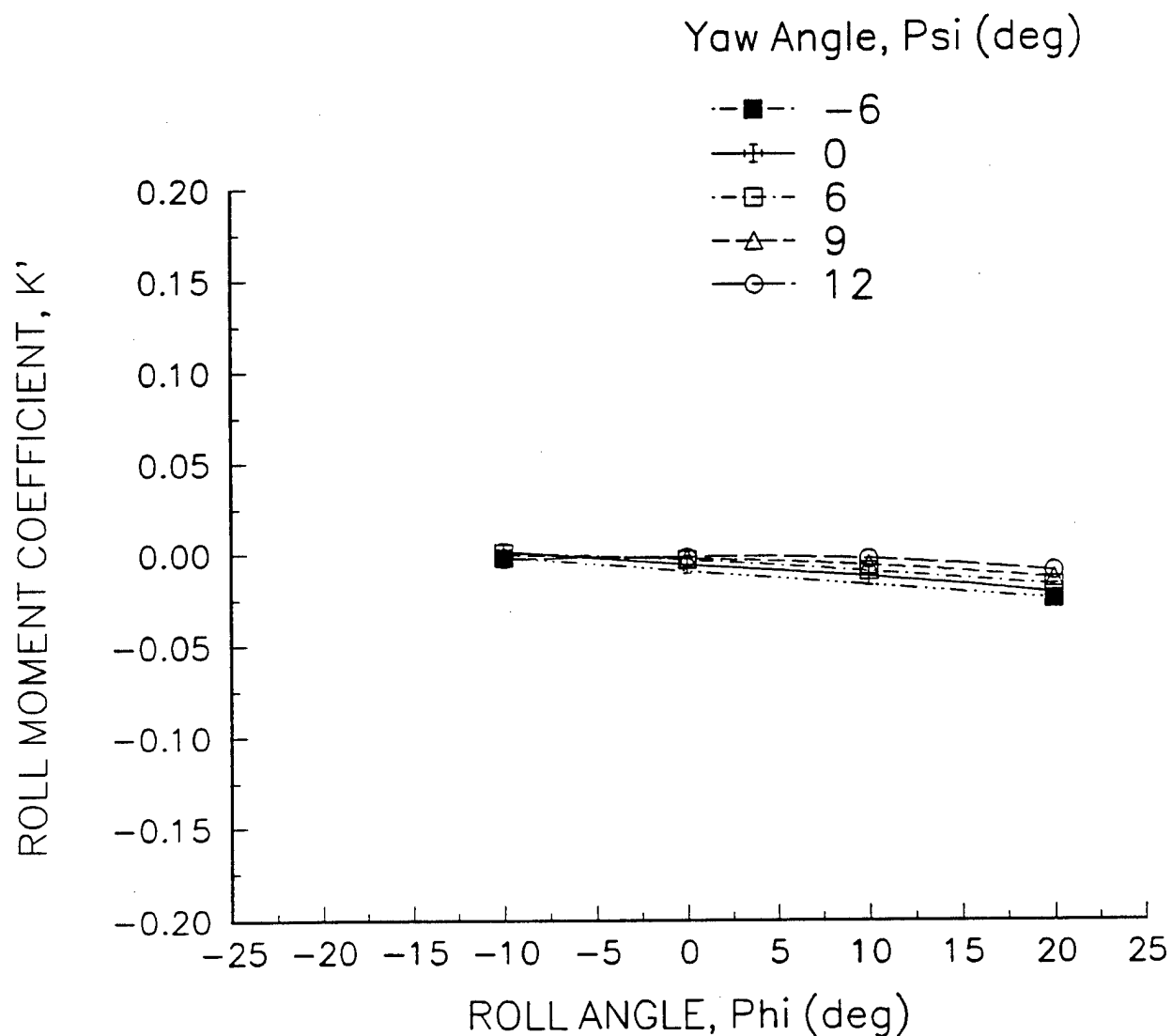


Figure D-63. K' versus Phi with Psi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.412 and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN
Displacement 135 LTons
Yaw Angle, $\Psi = -6$, Speed = 35 Knots

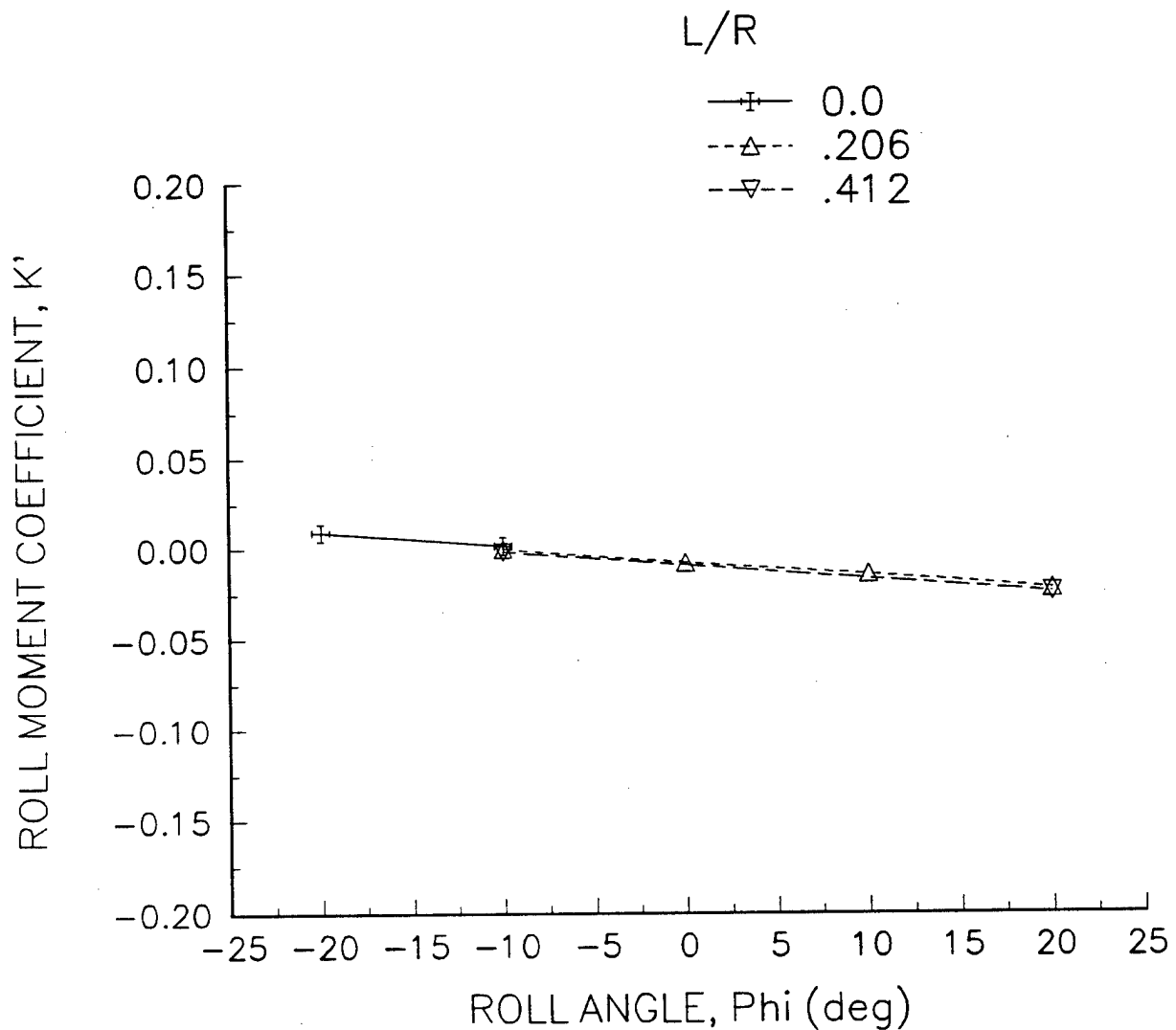


Figure D-64. K' versus Φ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Ψ of -6 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN
Displacement 135 L Tons
Yaw Angle, $\Psi = 0$, Speed = 35 Knots

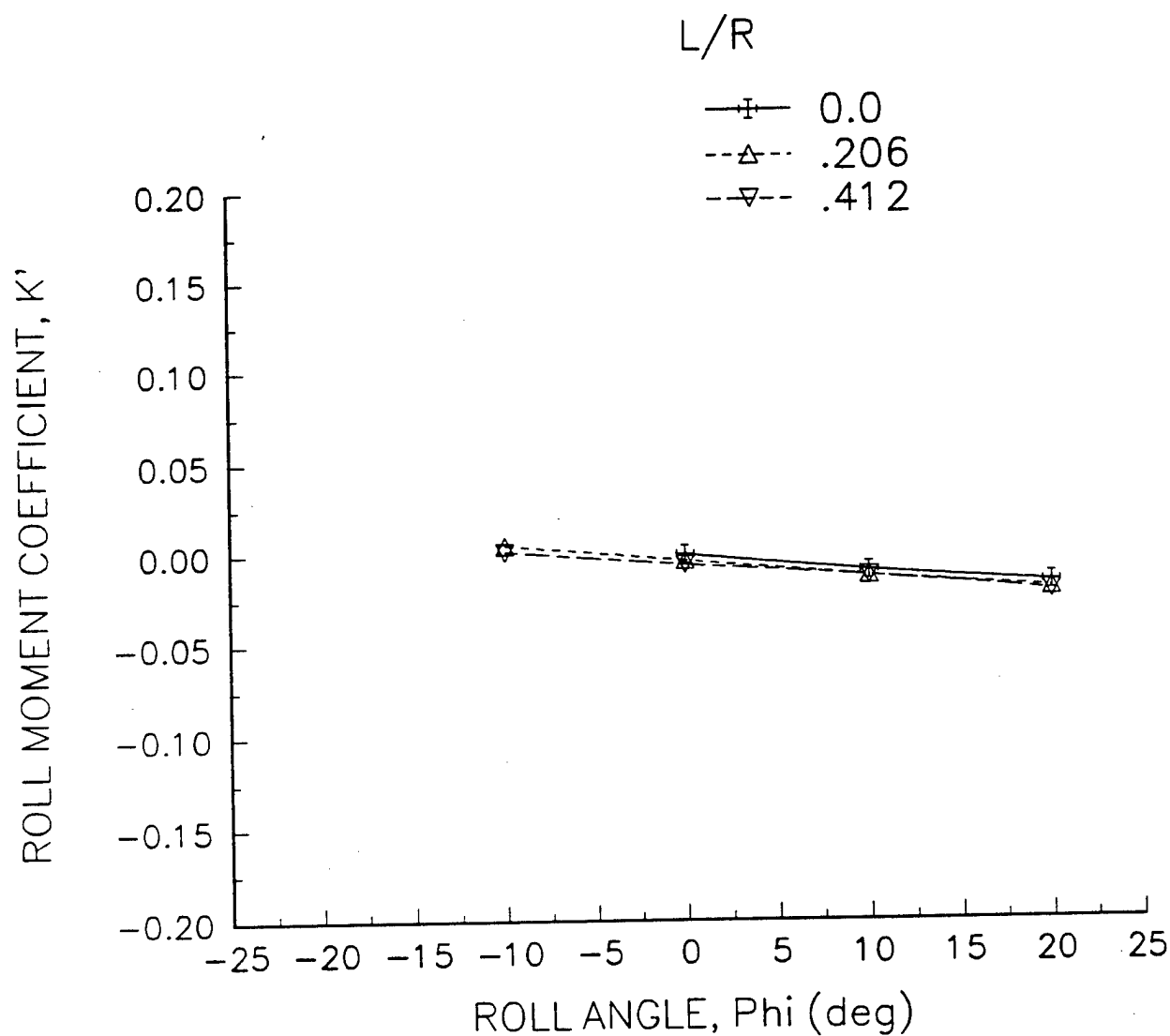


Figure D-65. K' versus Φ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Ψ of 0 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN
Displacement 135 LTons
Yaw Angle, $\Psi = 6$, Speed = 35 Knots

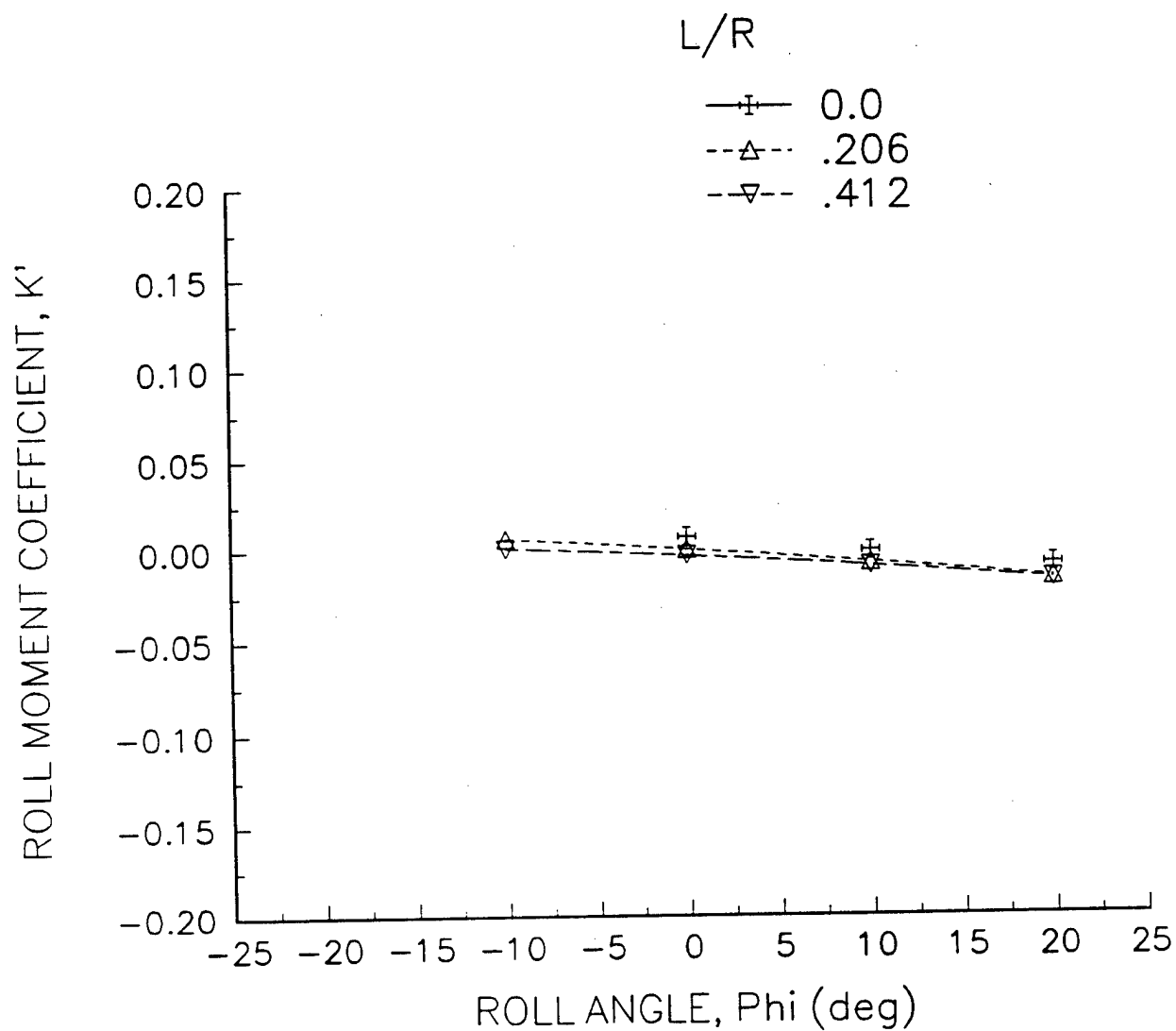


Figure D-66. K' versus Φ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Ψ of 6 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN
Displacement 135 LTons
Yaw Angle, $\Psi = 9$, Speed = 35 Knots

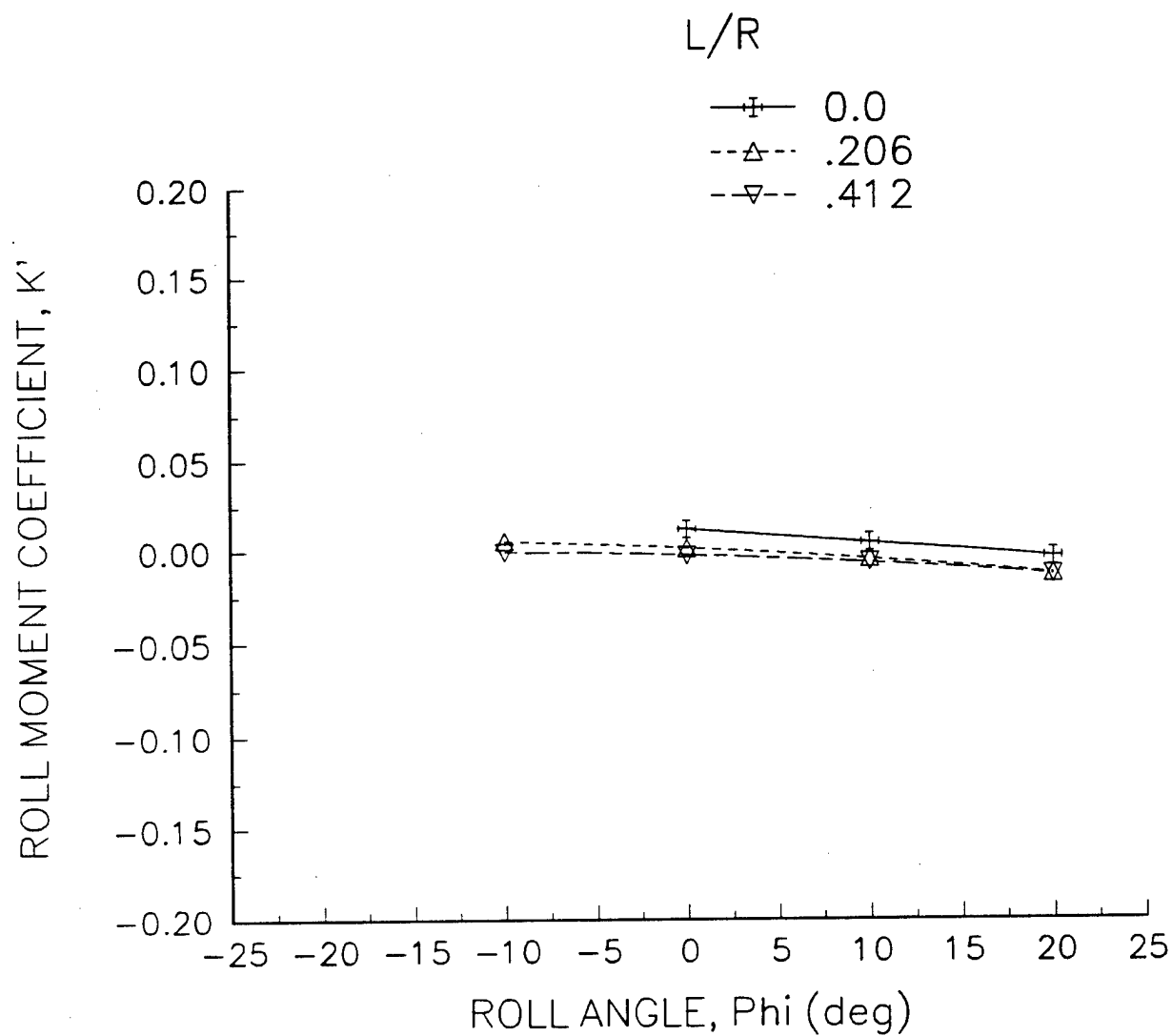


Figure D-67. K' versus Φ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 9 degrees and a speed of 35 knots.

1 20 FT NOTIONAL WPB DESIGN
Displacement 1 35 LTons
Yaw Angle, $\Psi = 12$, Speed = 35 Knots

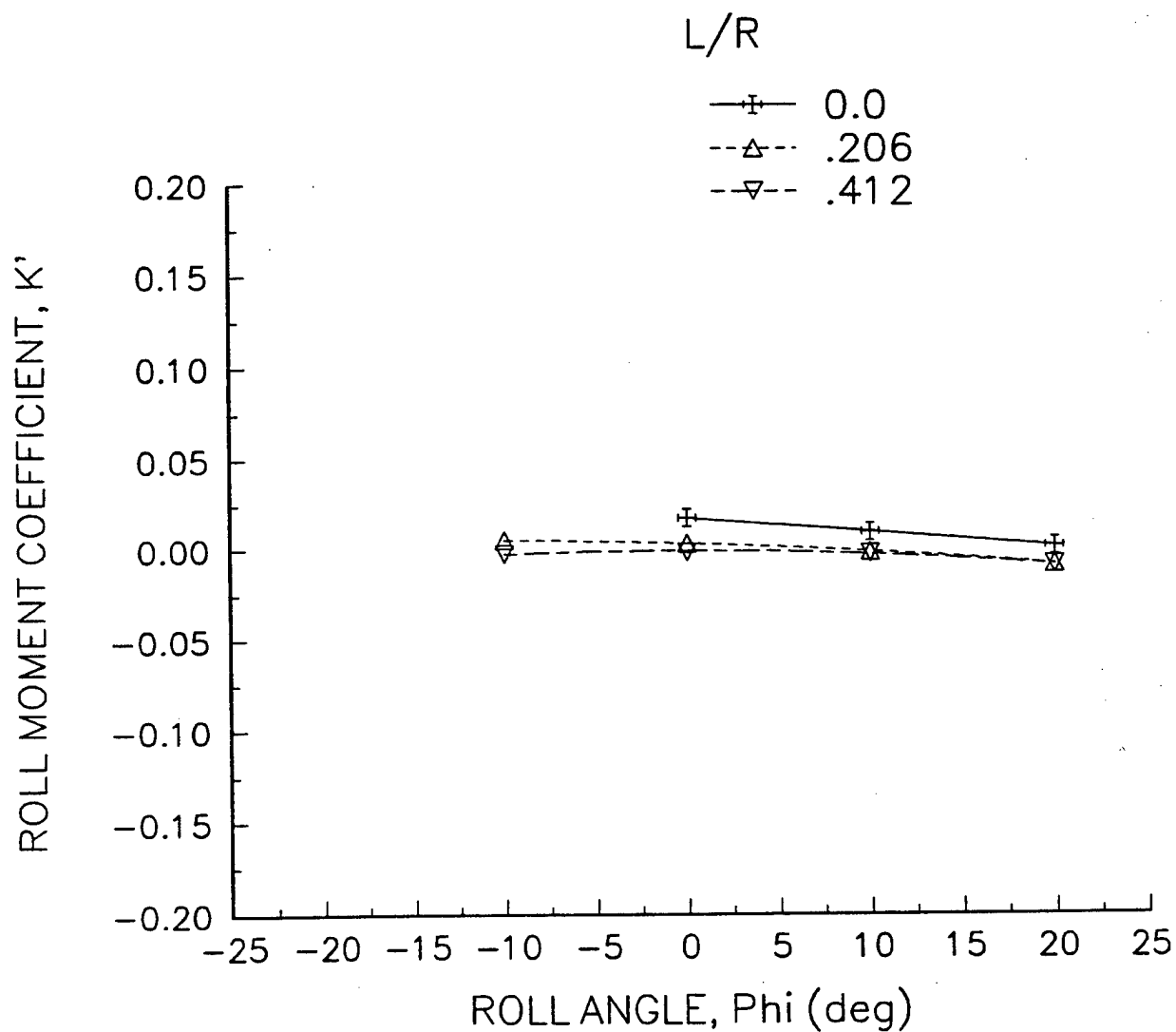


Figure D-68. K' versus Φ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Ψ of 12 degrees and a speed of 35 knots.

1 20 FT NOTIONAL WPB DESIGN

Displacement 1 35 LTons

Roll Angle, Φ (deg) = -10, Speed = 35 Knots

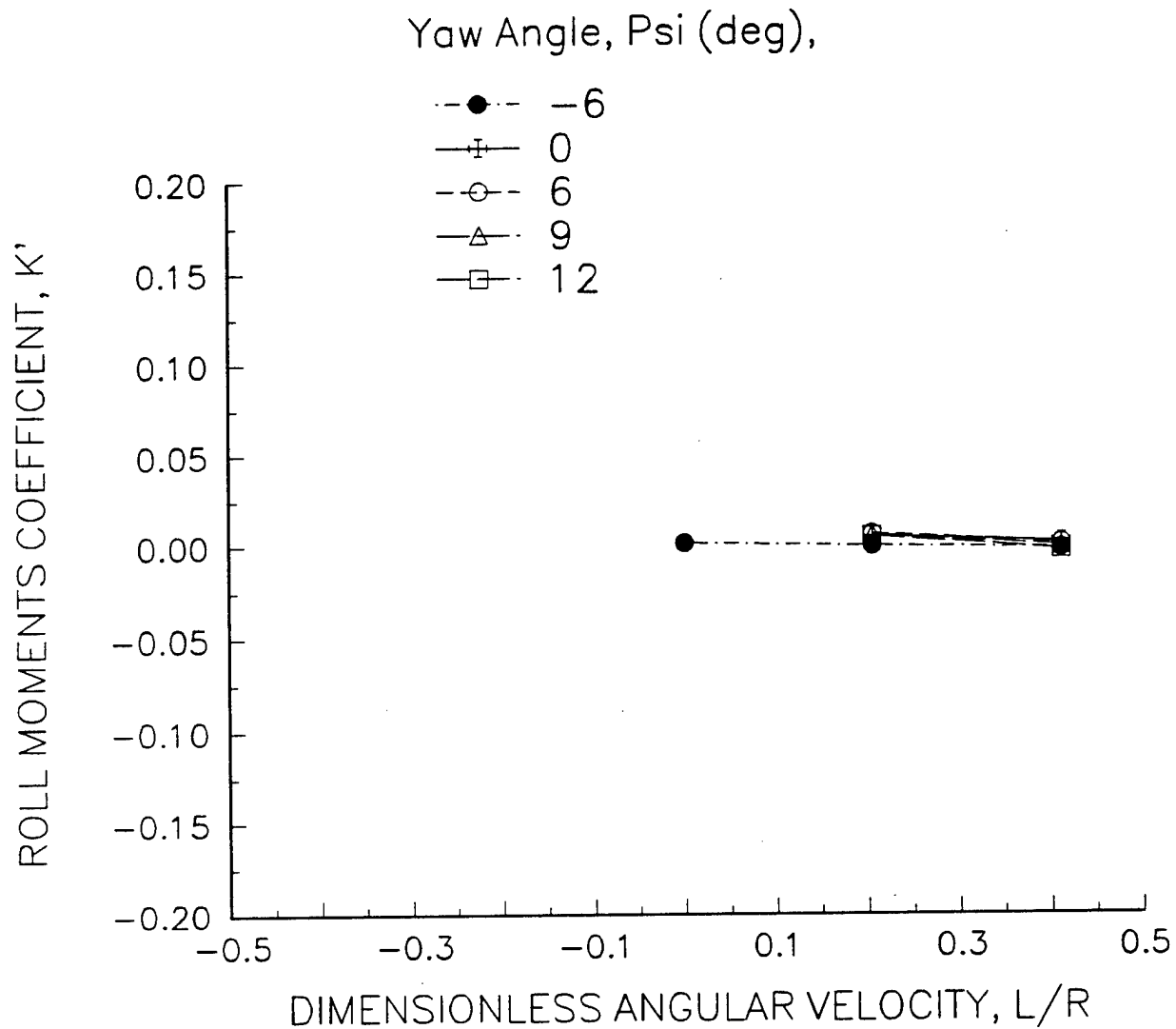


Figure D-69. K' versus L/R with Ψ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of -10 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Roll Angle, Φ (deg) = 0, Speed = 35 Knots

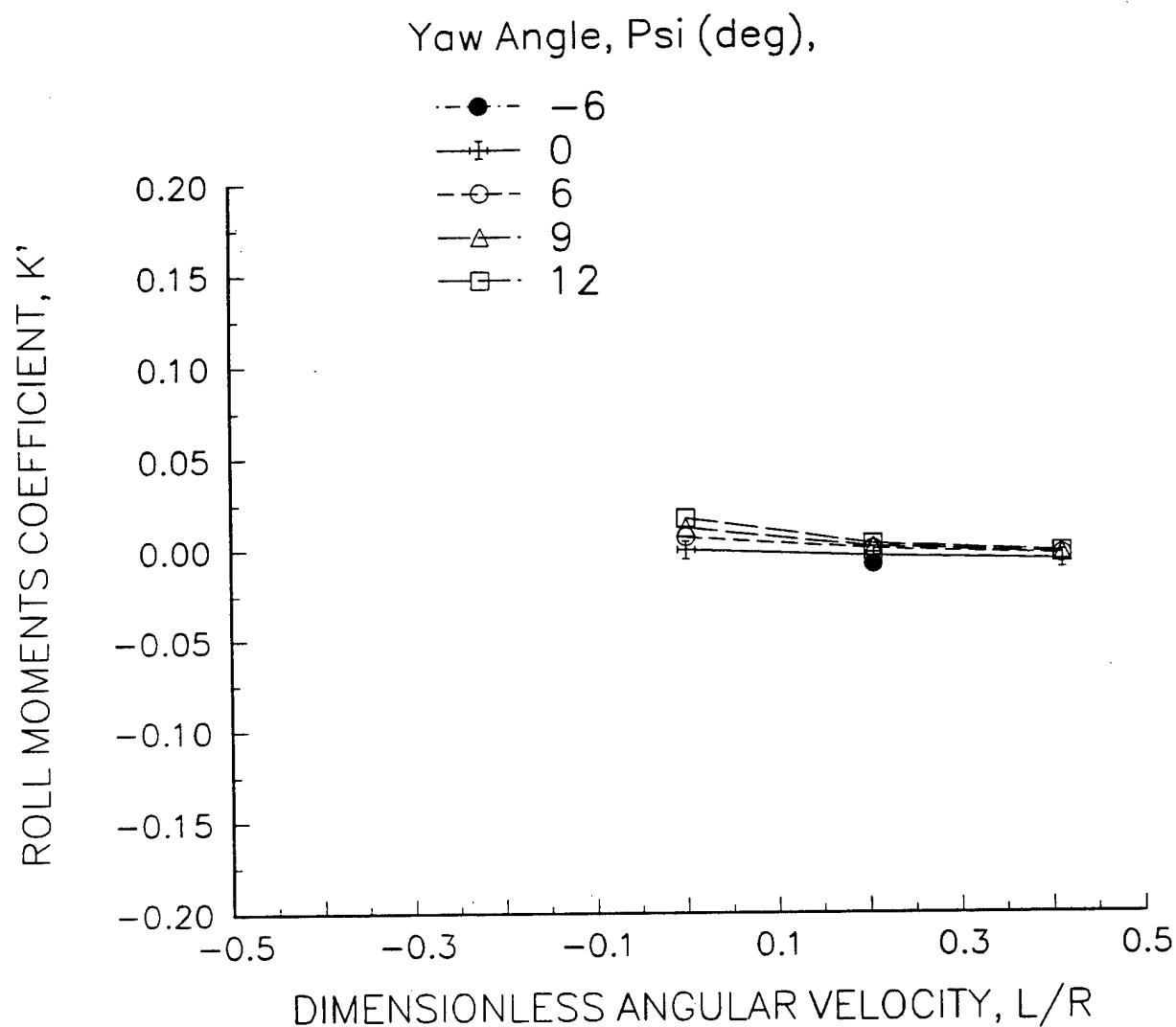


Figure D-70. K' versus L/R with Ψ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 0 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Roll Angle, Φ (deg) = 10, Speed = 35 Knots

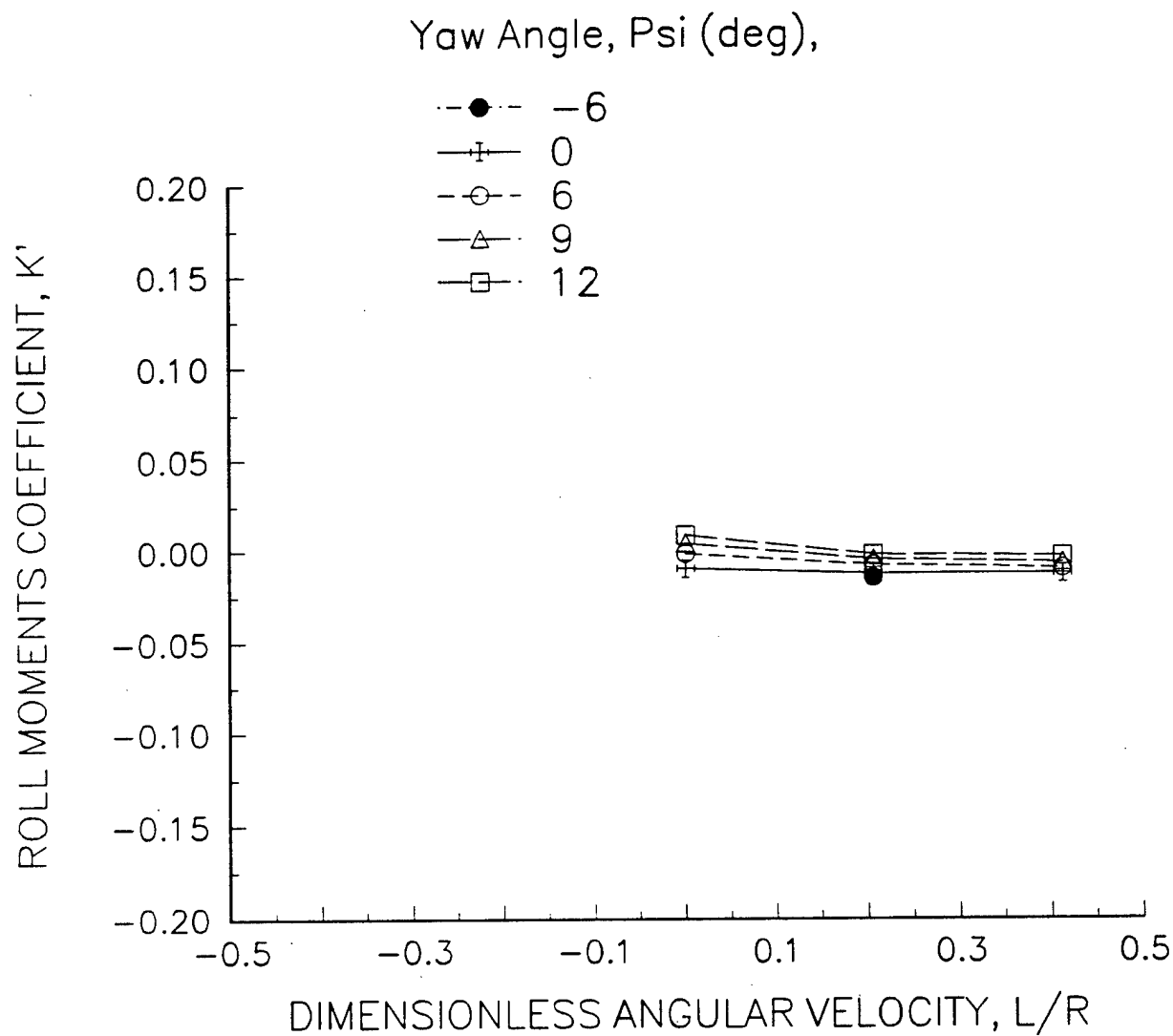


Figure D-71. K' versus L/R with Ψ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 10 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Roll Angle, Φ (deg) = 20, Speed = 35 Knots

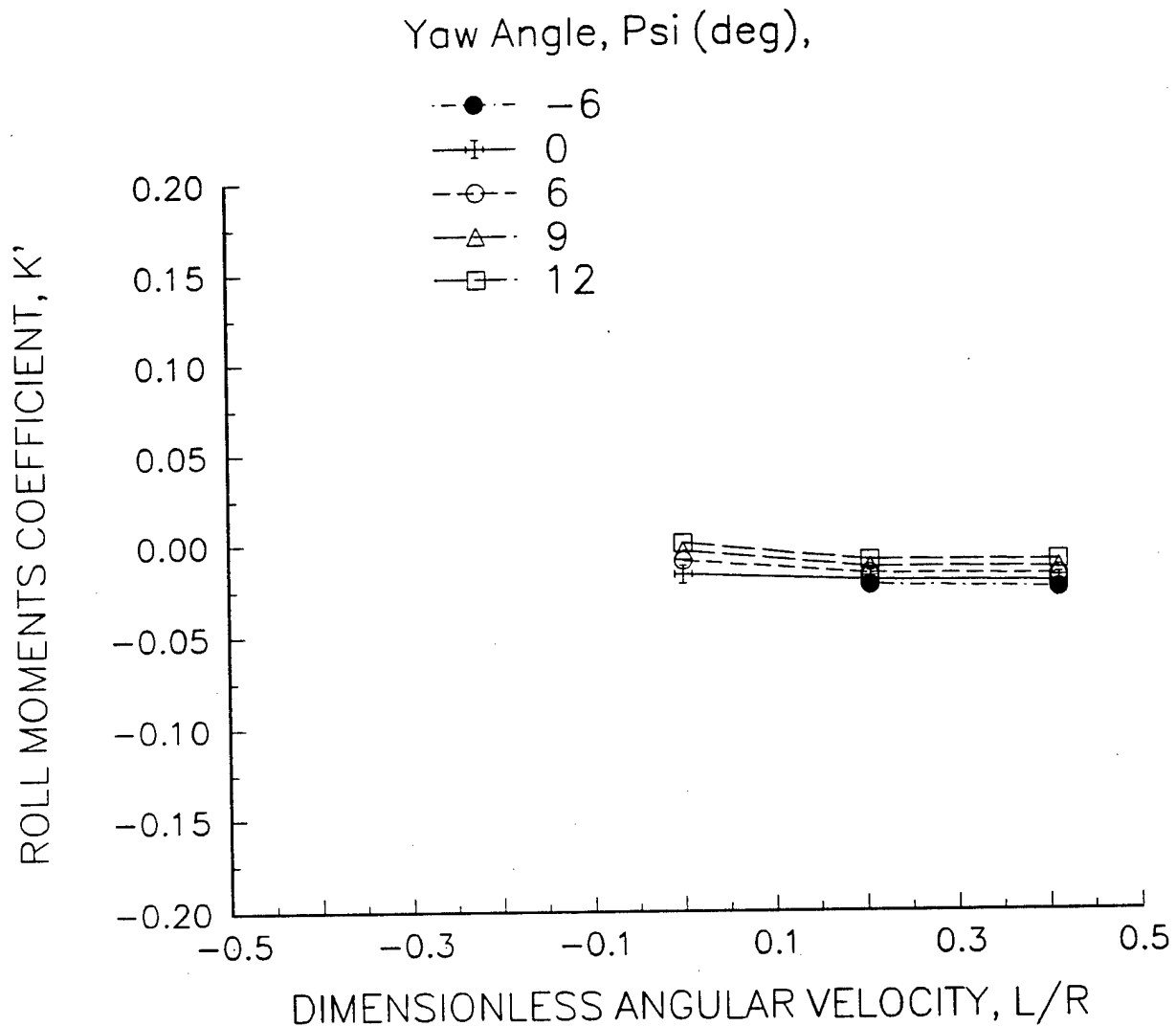


Figure D-72. K' versus L/R with Ψ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 20 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons
L/R=0, Speed = 12.5 Knots

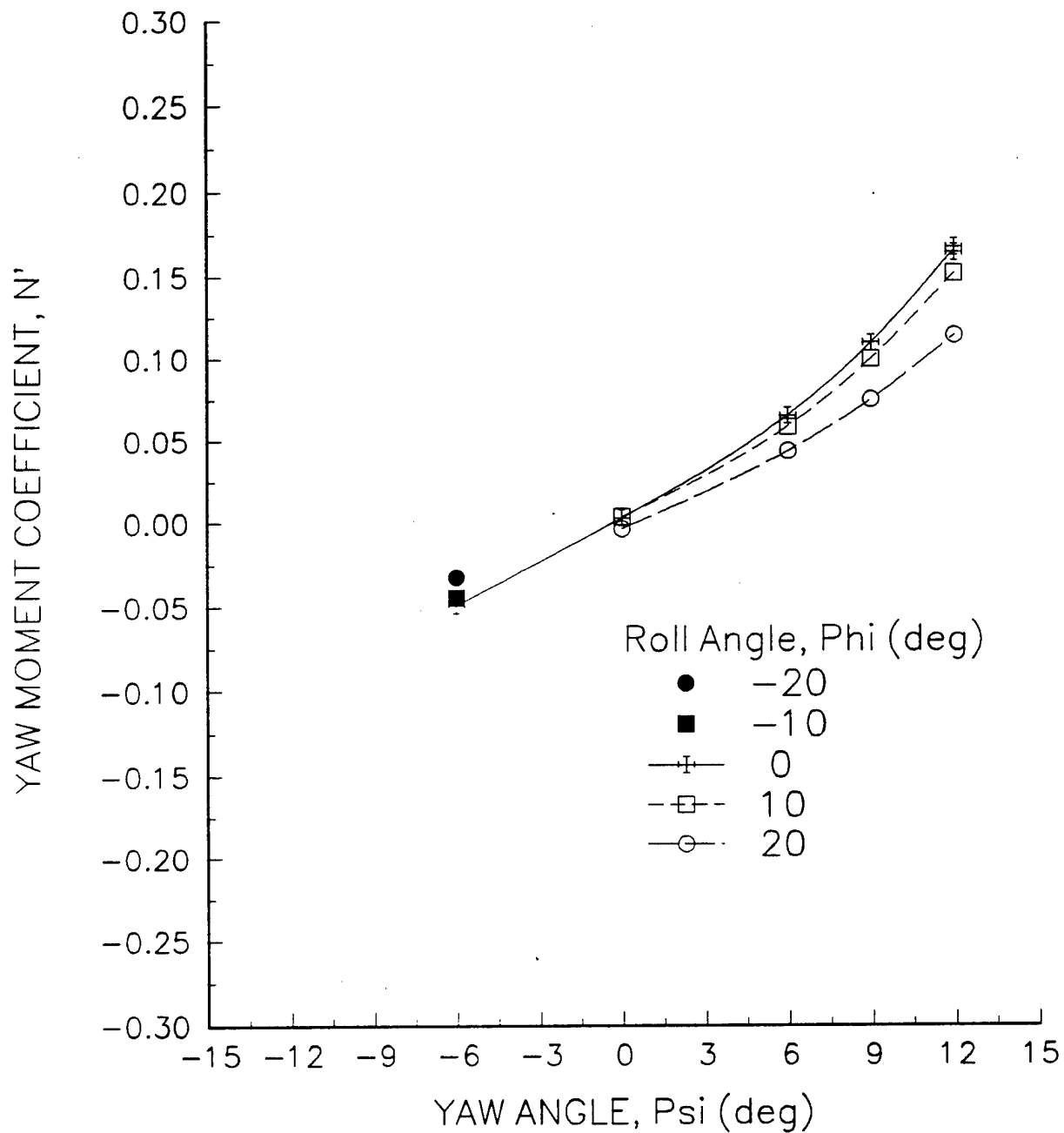


Figure D-73. N' versus Ψ with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.000 and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

L/R=.206, Speed = 12.5 Knots

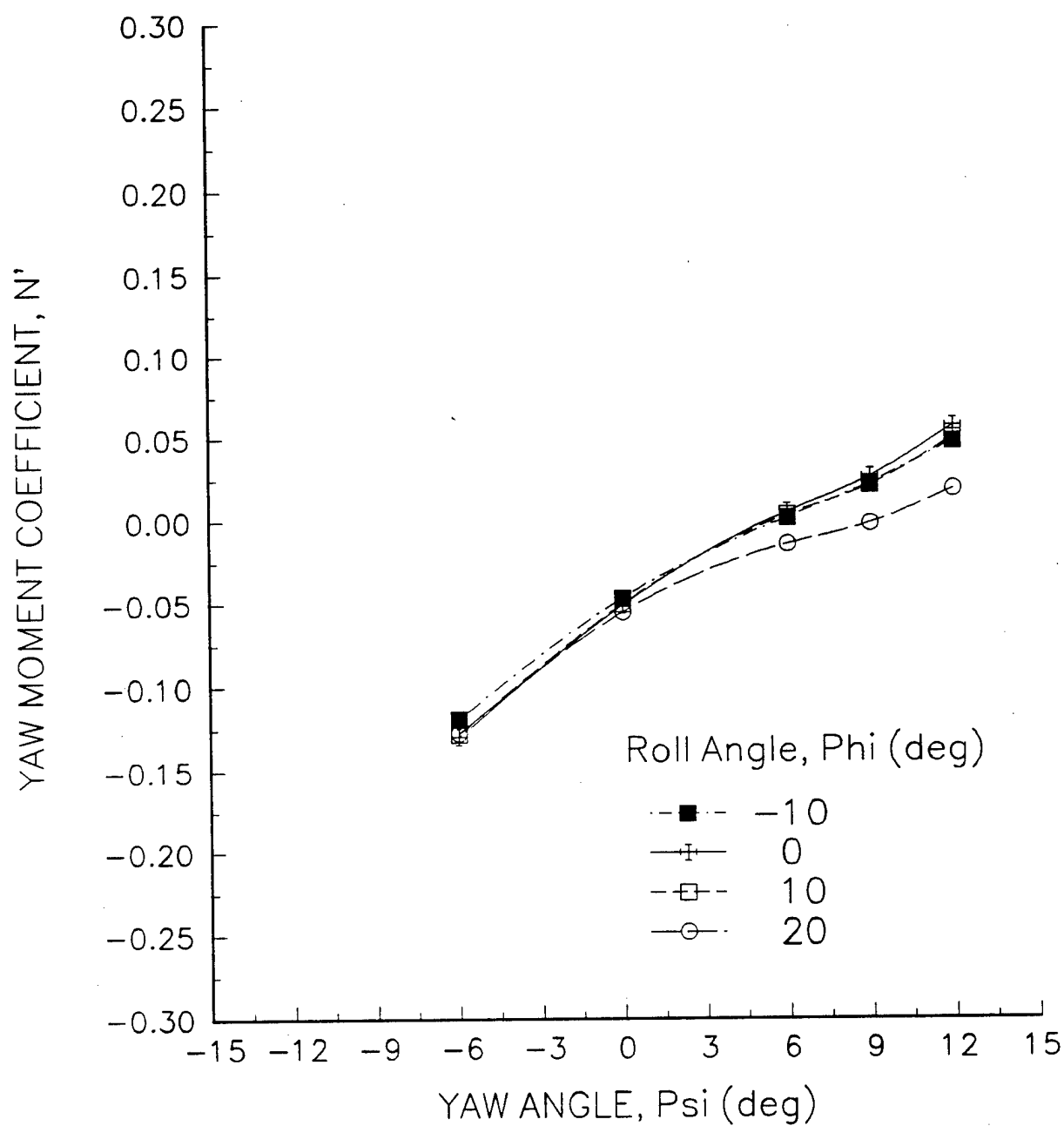


Figure D-74. N' versus Ψ with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.206 and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 L.Tons

$L/R=.412$, Speed = 12.5 Knots

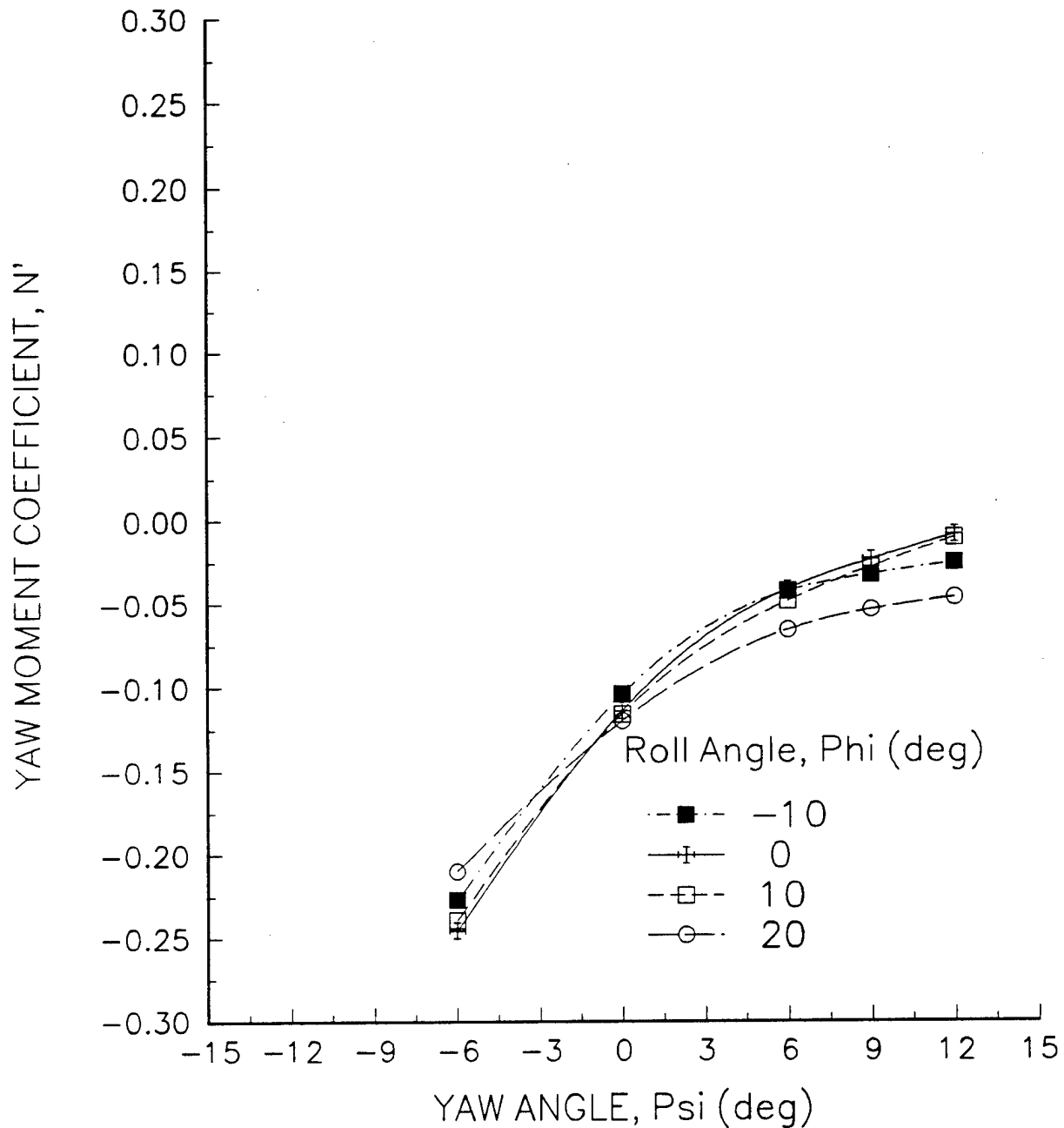


Figure D-75. N' versus Ψ with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.412 and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN
 Displacement 135 LTons
 ROLL ANGLE, Φ (deg) = -10, Speed = 12.5 Knots

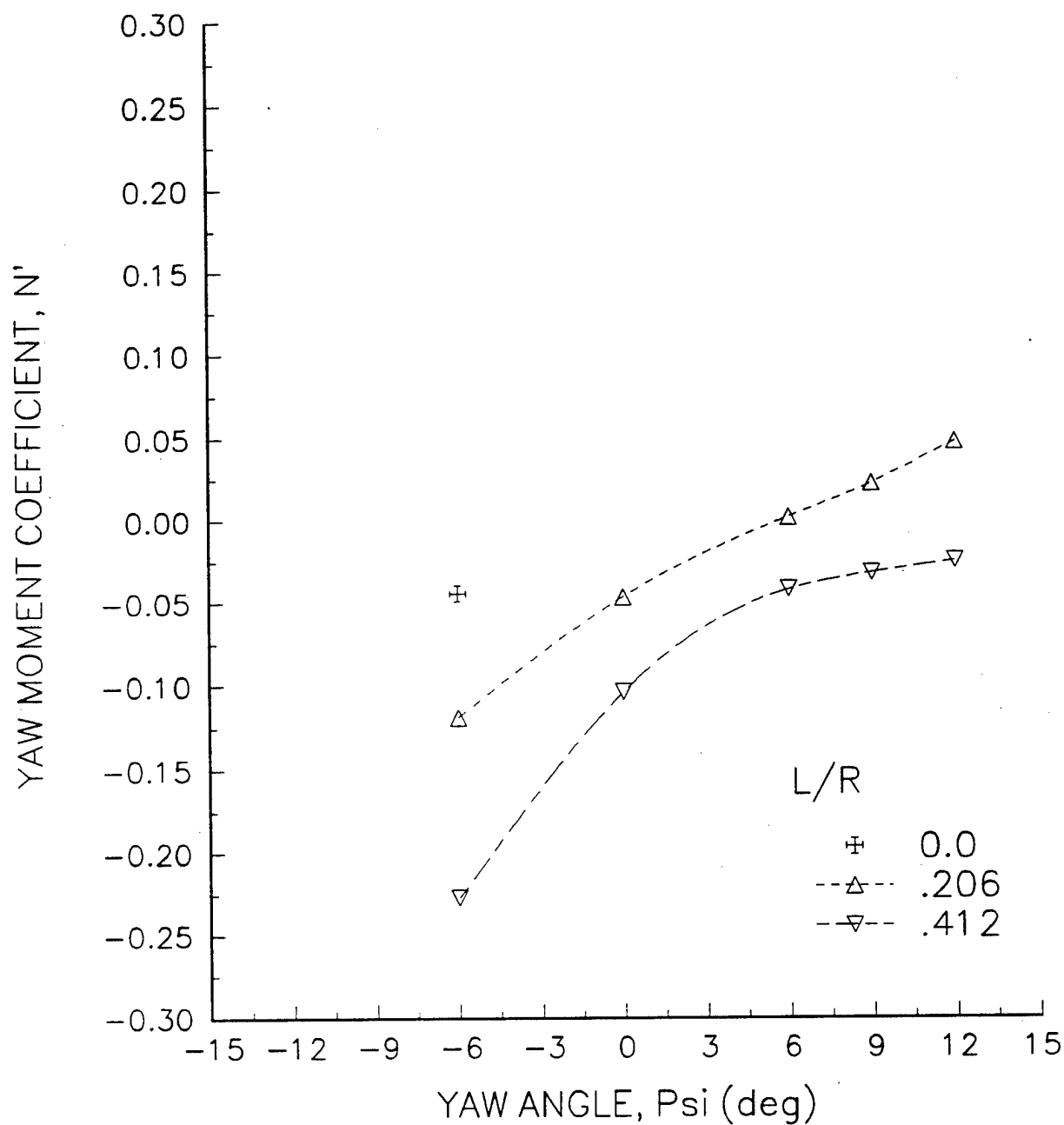


Figure D-76. N' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of -10 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN
 Displacement 135 LTons
 ROLL ANGLE, Φ (deg) = 0, Speed = 12.5 Knots

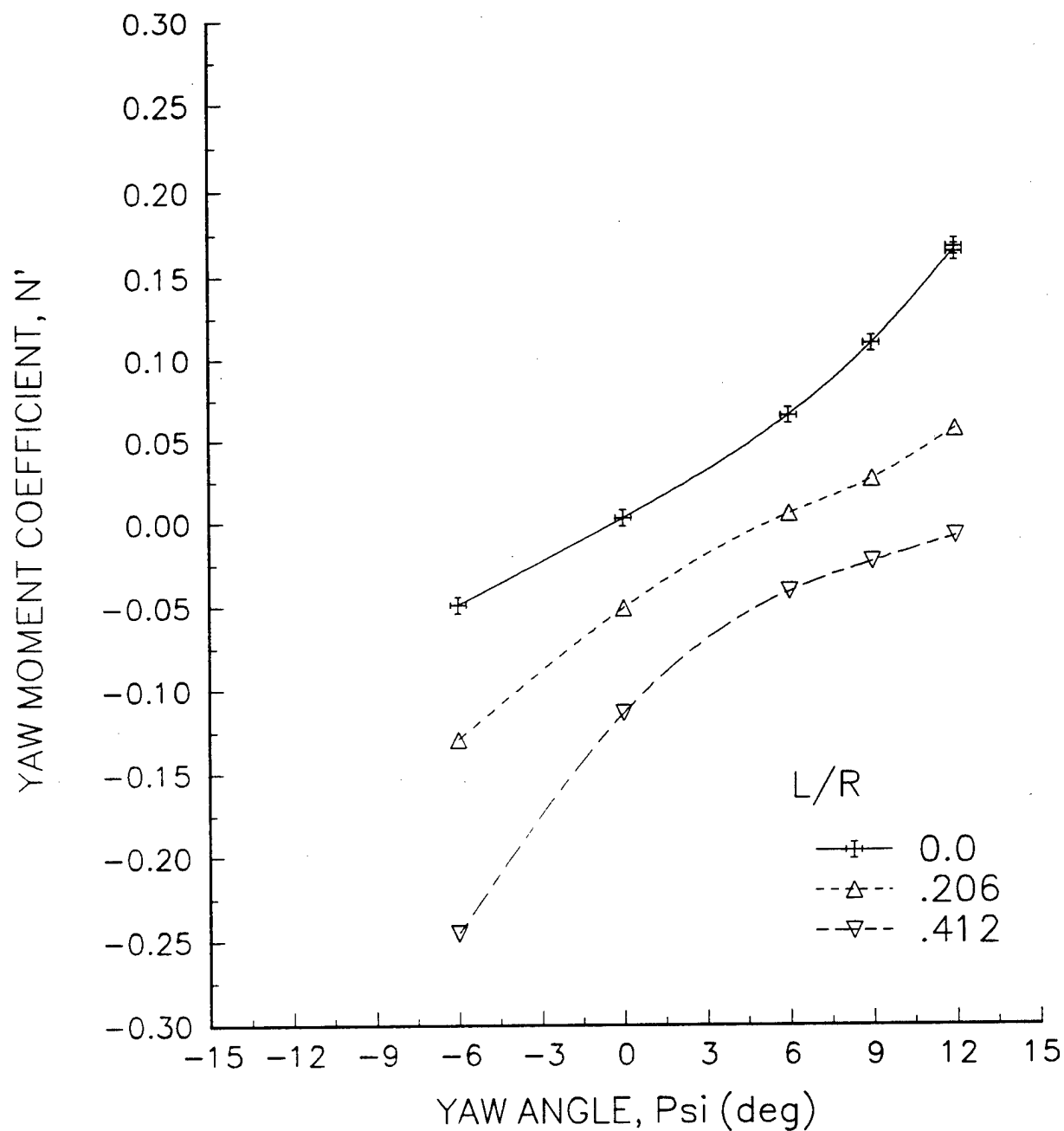


Figure D-77. N' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 0 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN
 Displacement 135 LTons
 ROLL ANGLE, Φ (deg) = 10, Speed = 12.5 Knots

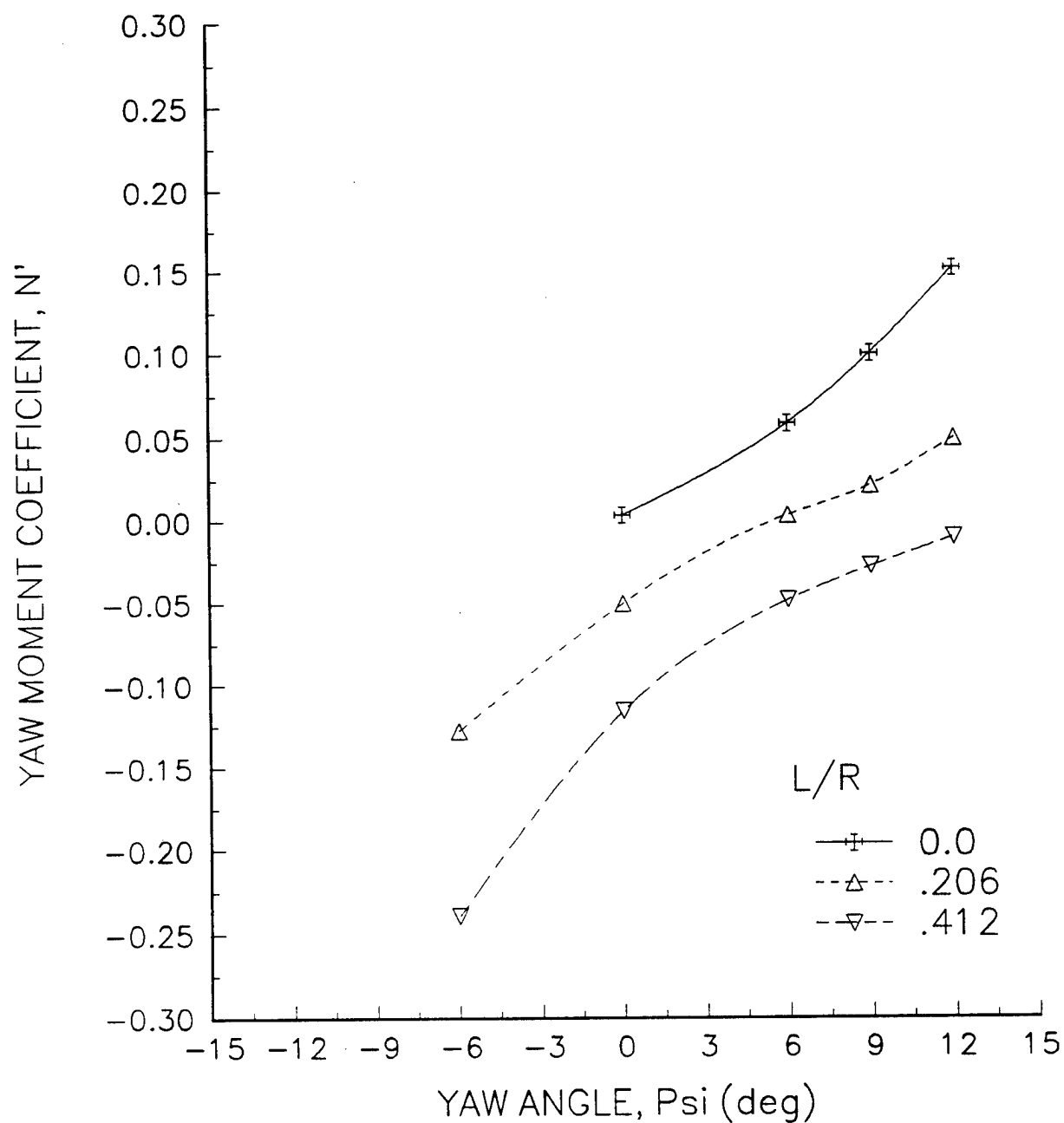


Figure D-78. N' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 10 degrees and a speed of 12.5 knots.

1 20 FT NOTIONAL WPB DESIGN
 Displacement 135 LTons
 ROLL ANGLE, Φ (deg) = 20, Speed = 12.5 Knots

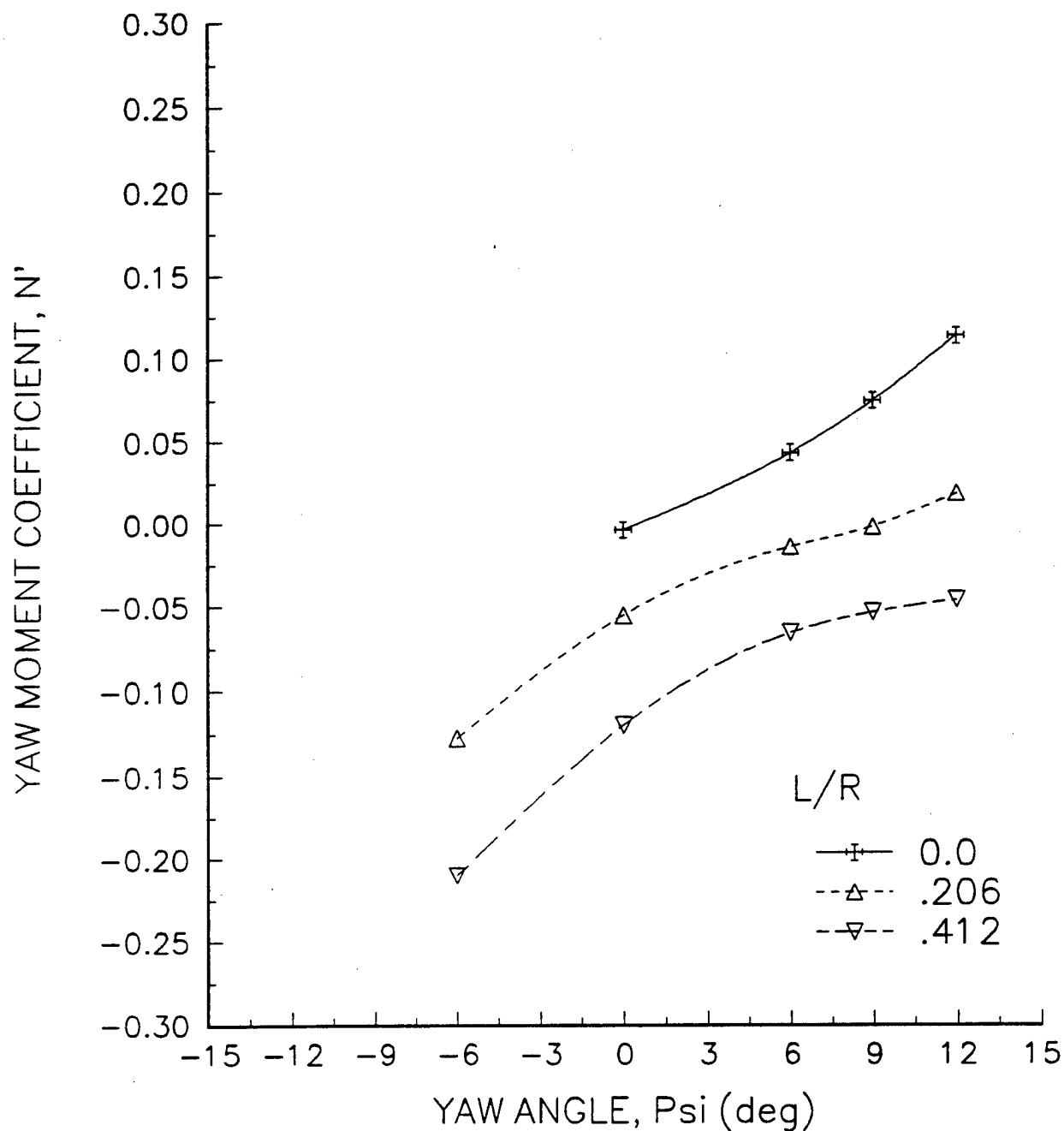


Figure D-79. N' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 20 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Yaw Angle, Psi (deg) = -6, Speed = 12.5 Knots

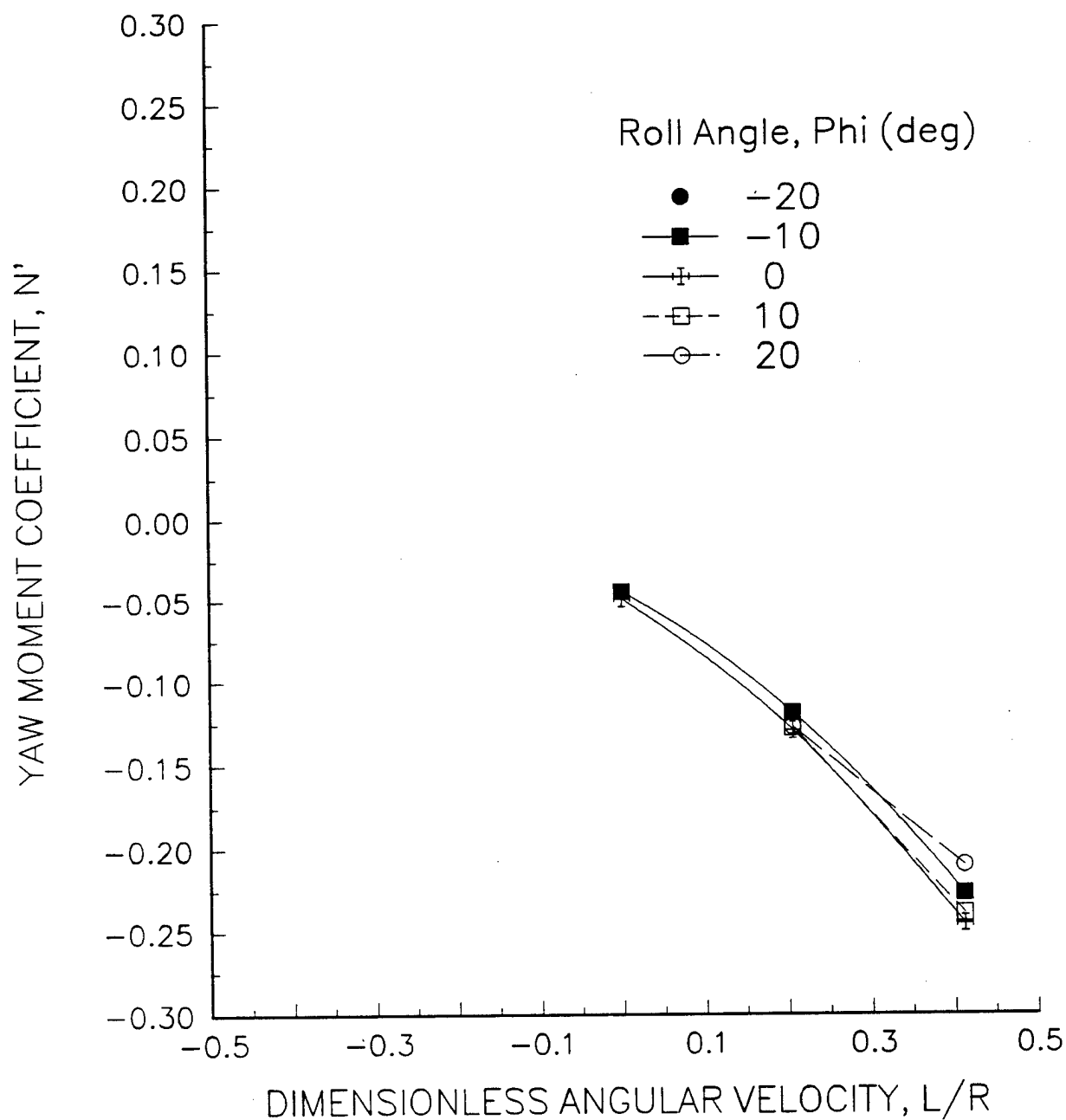


Figure D-80. N' versus L/R with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of -6 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Yaw Angle, Psi (deg) = 0, Speed = 12.5 Knots

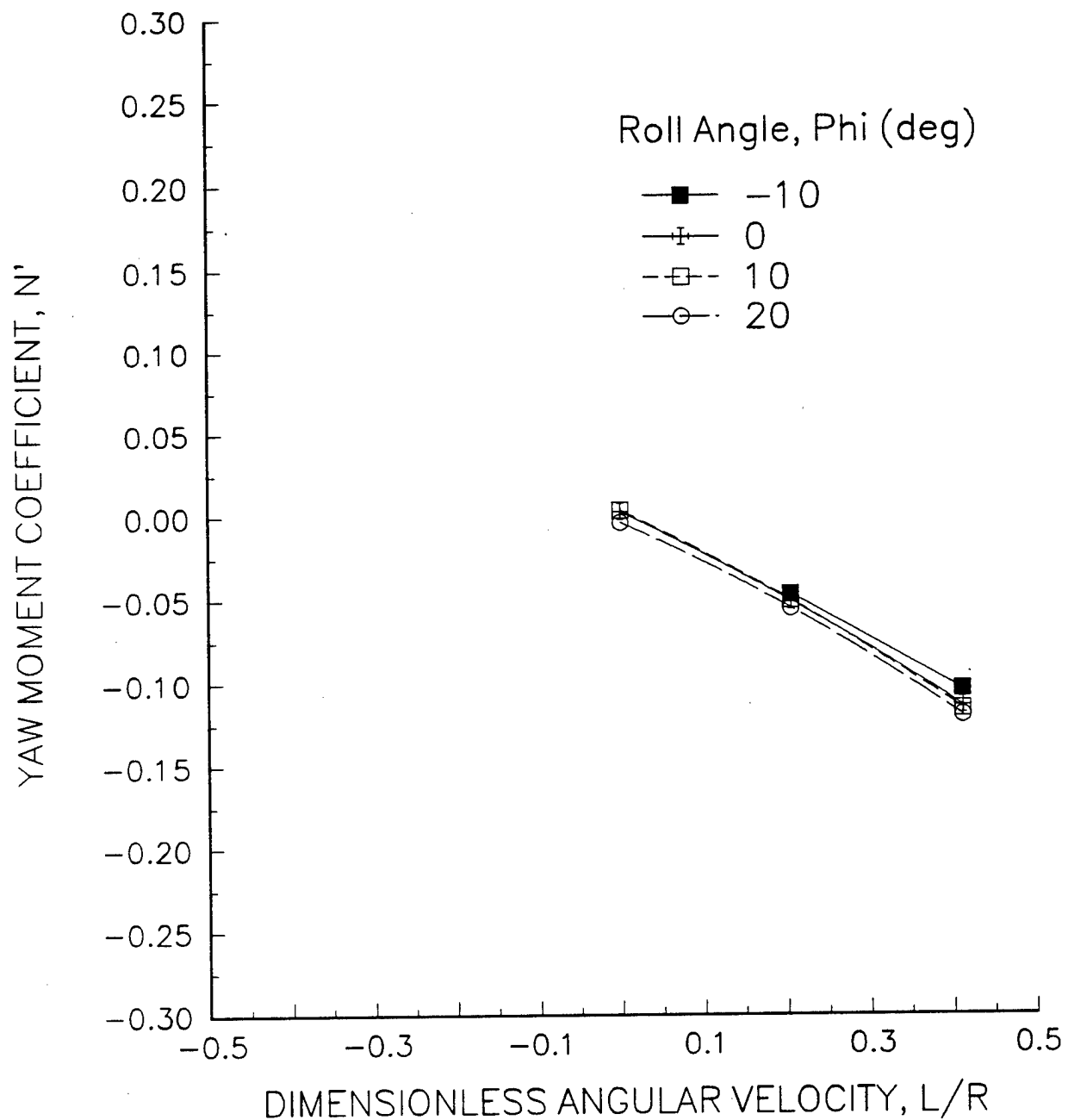


Figure D-81. N' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 0 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Yaw Angle, Psi (deg) = 6, Speed = 12.5 Knots

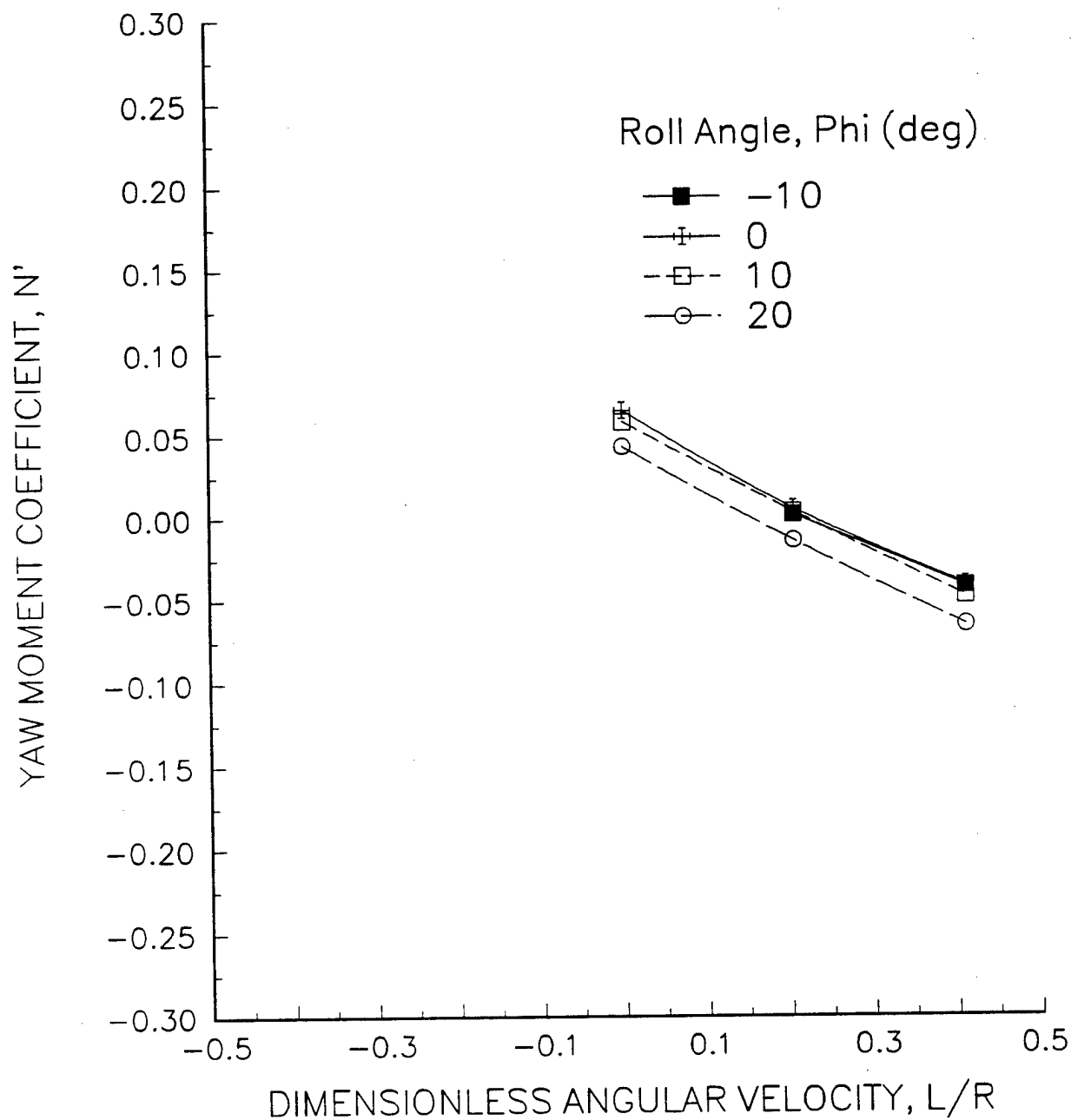


Figure D-82. N' versus L/R with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 6 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Yaw Angle, Psi (deg) = 9, Speed = 12.5 Knots

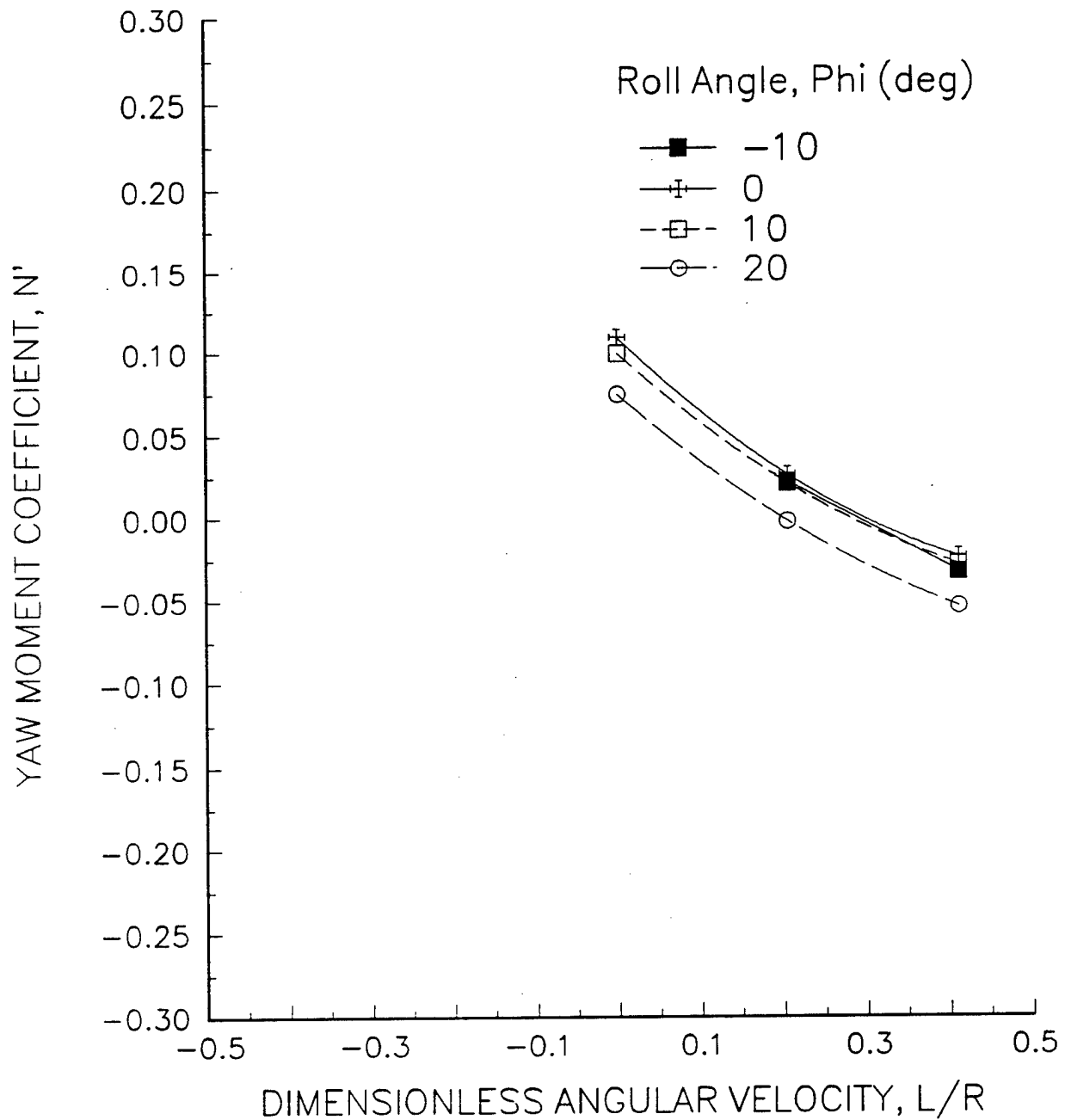


Figure D-83. N' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 9 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Yaw Angle, Psi (deg) = 12, Speed = 12.5 Knots

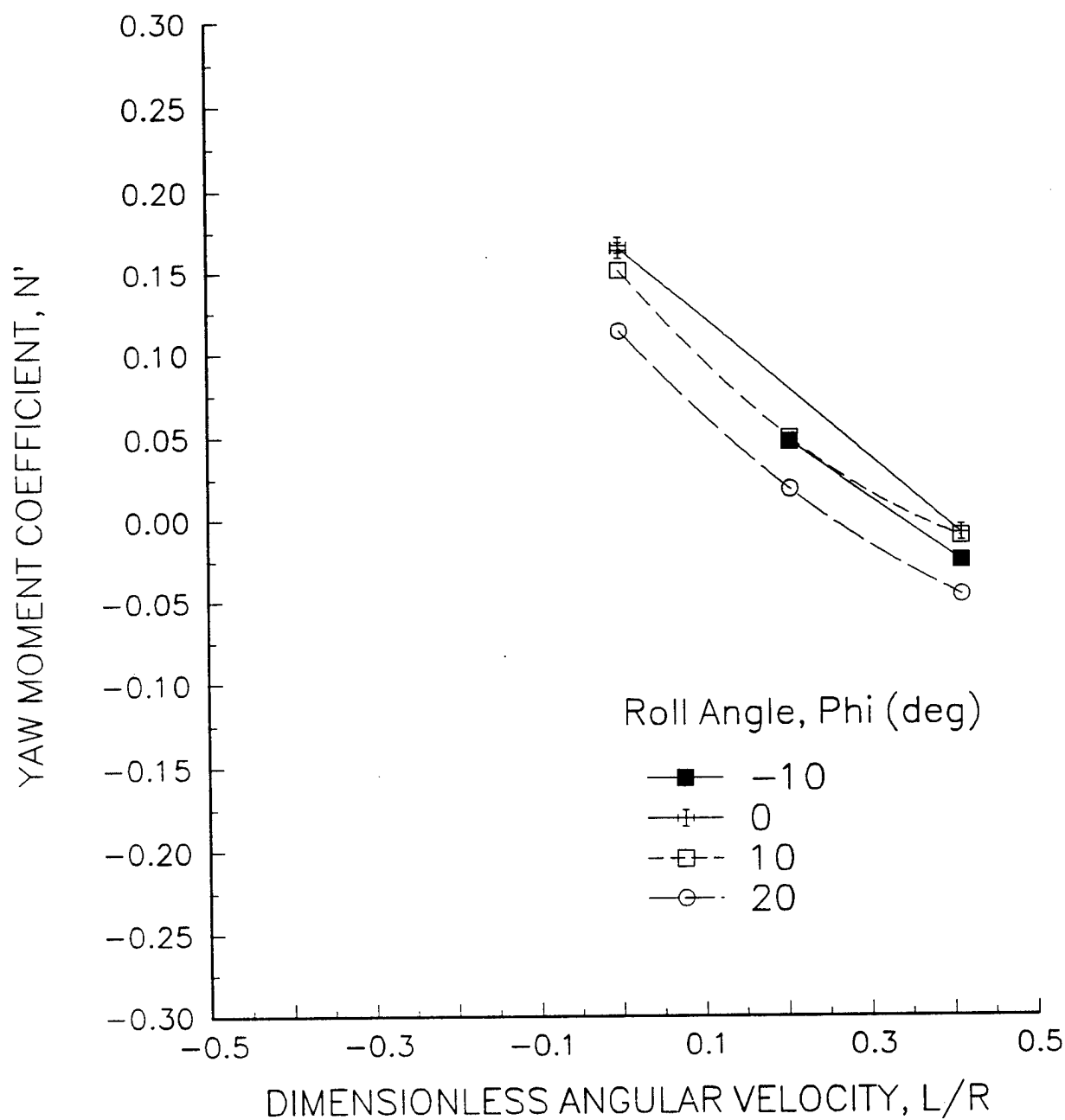


Figure D-84. N' versus L/R with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 12 degrees and a speed of 12.5 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

L/R=0, Speed = 35 Knots

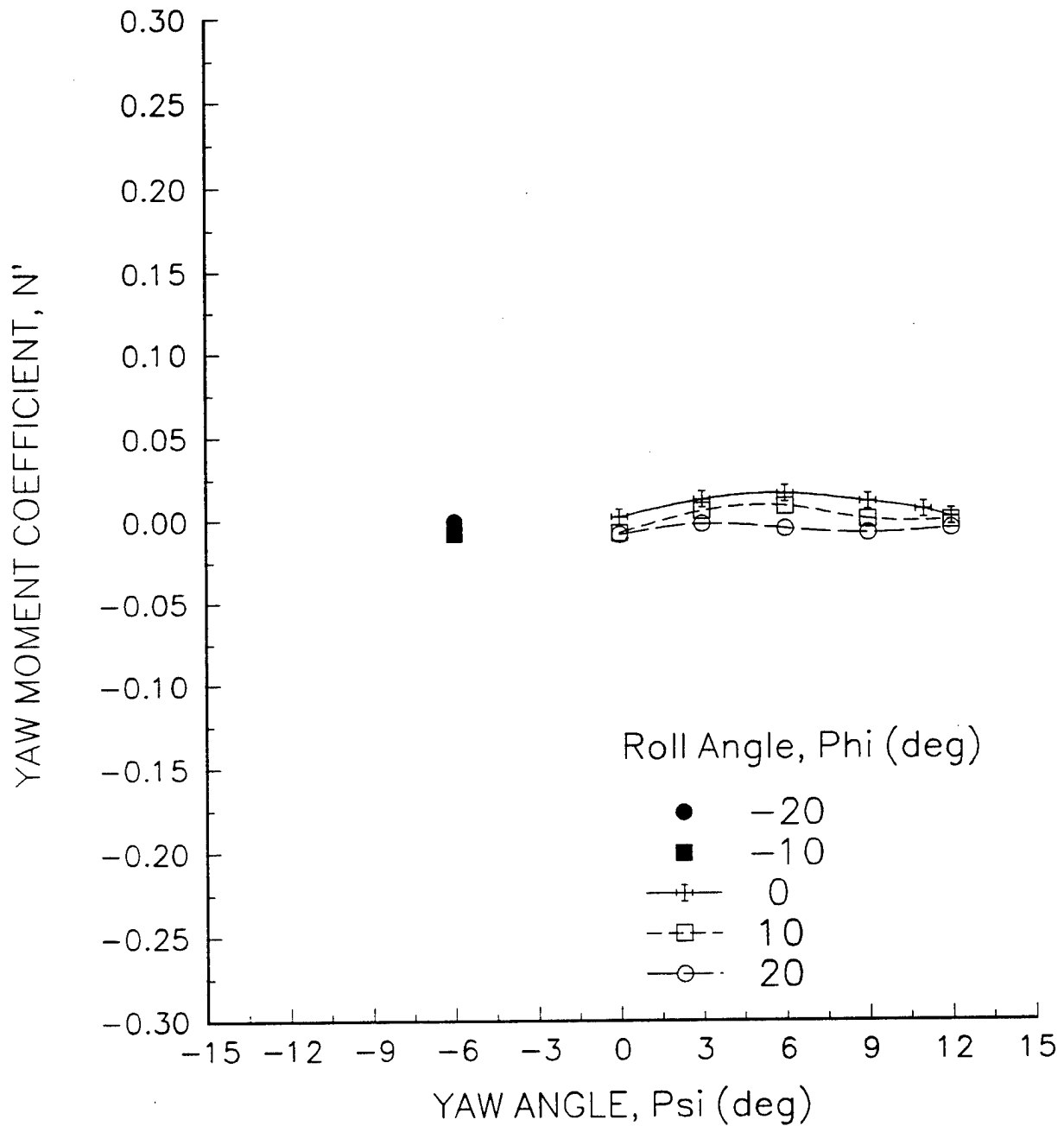


Figure D-85. N' versus Ψ with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.000 and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

$L/R = .206$, Speed = 35 Knots

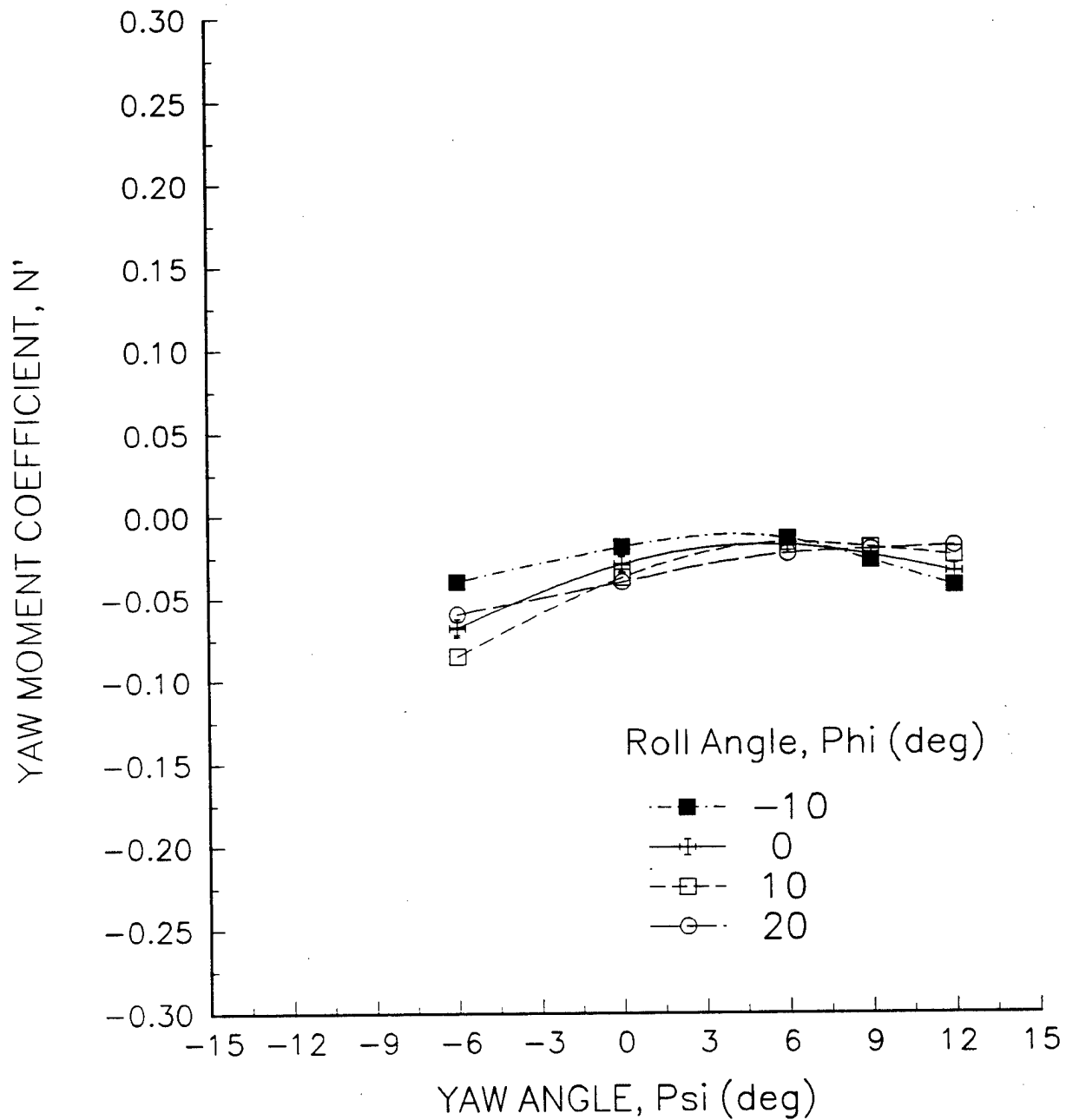


Figure D-86. N' versus Ψ with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.206 and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

L/R=.412, Speed = 35 Knots

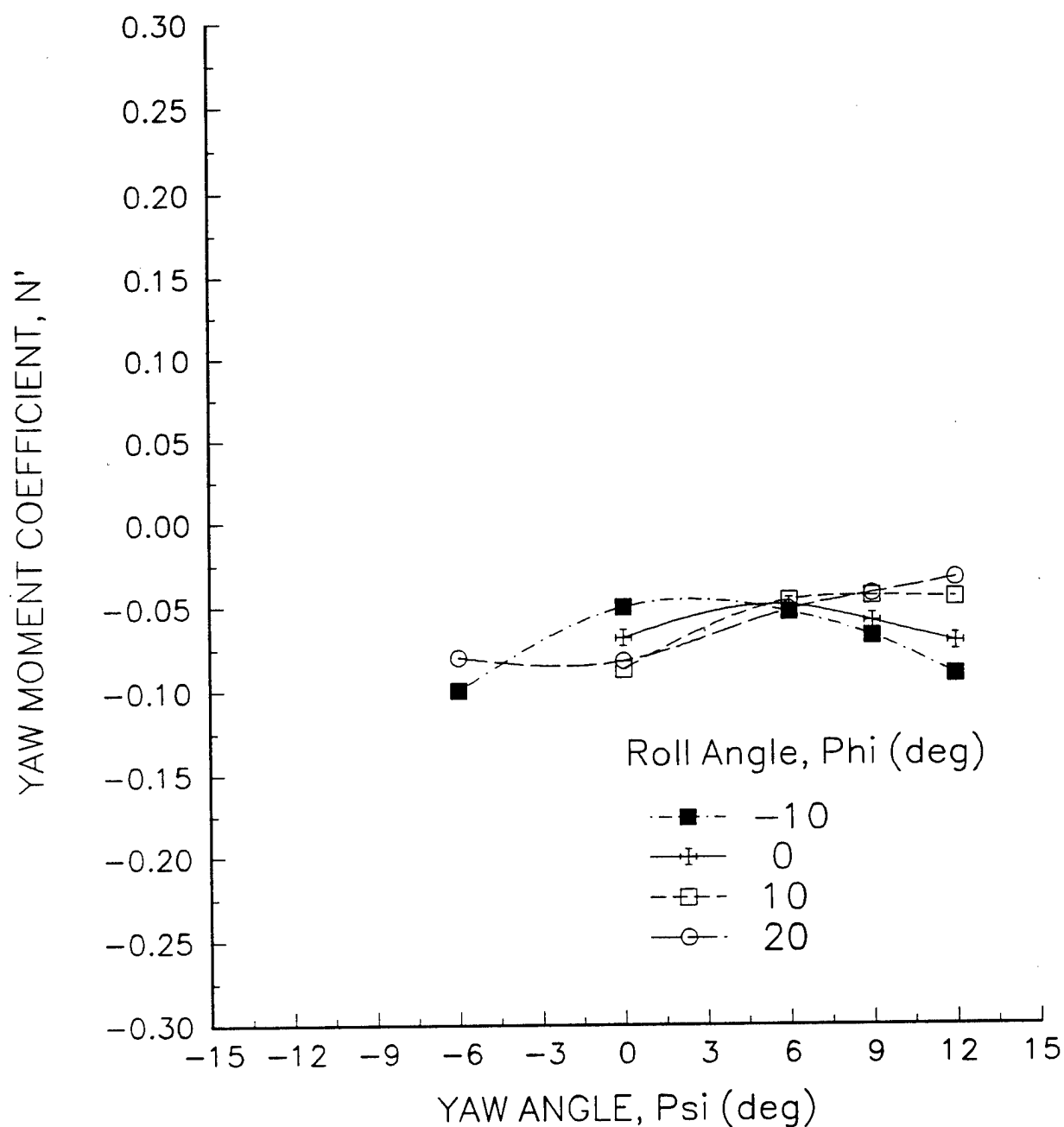


Figure D-87. N' versus Ψ with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at an L/R of 0.412 and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN
 Displacement 135 LTons
 ROLL ANGLE, Φ (deg) = -10, Speed = 35 Knots

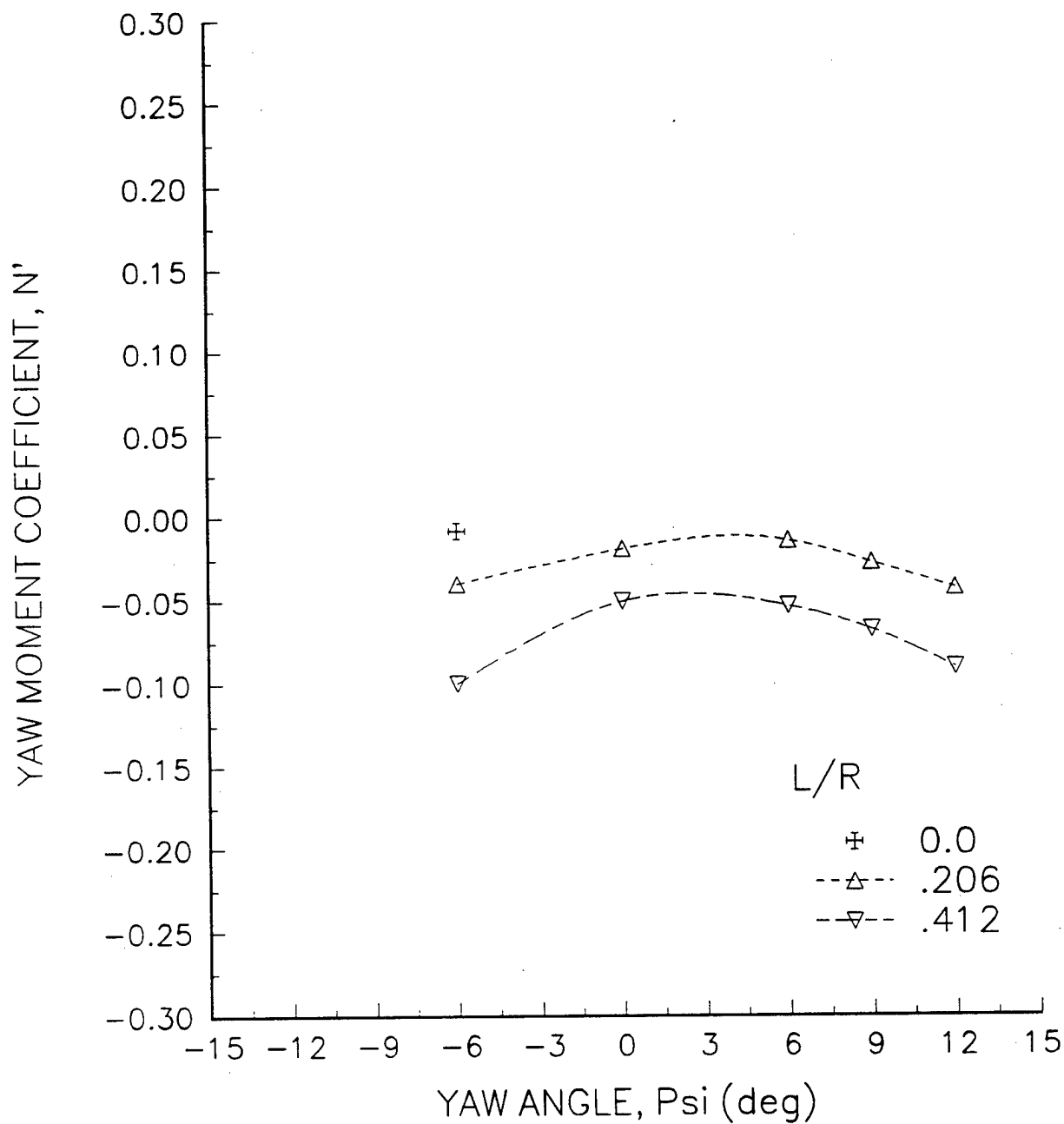


Figure D-88. N' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of -10 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN
Displacement 135 LTons
ROLL ANGLE, Φ (deg) = 0, Speed = 35 Knots

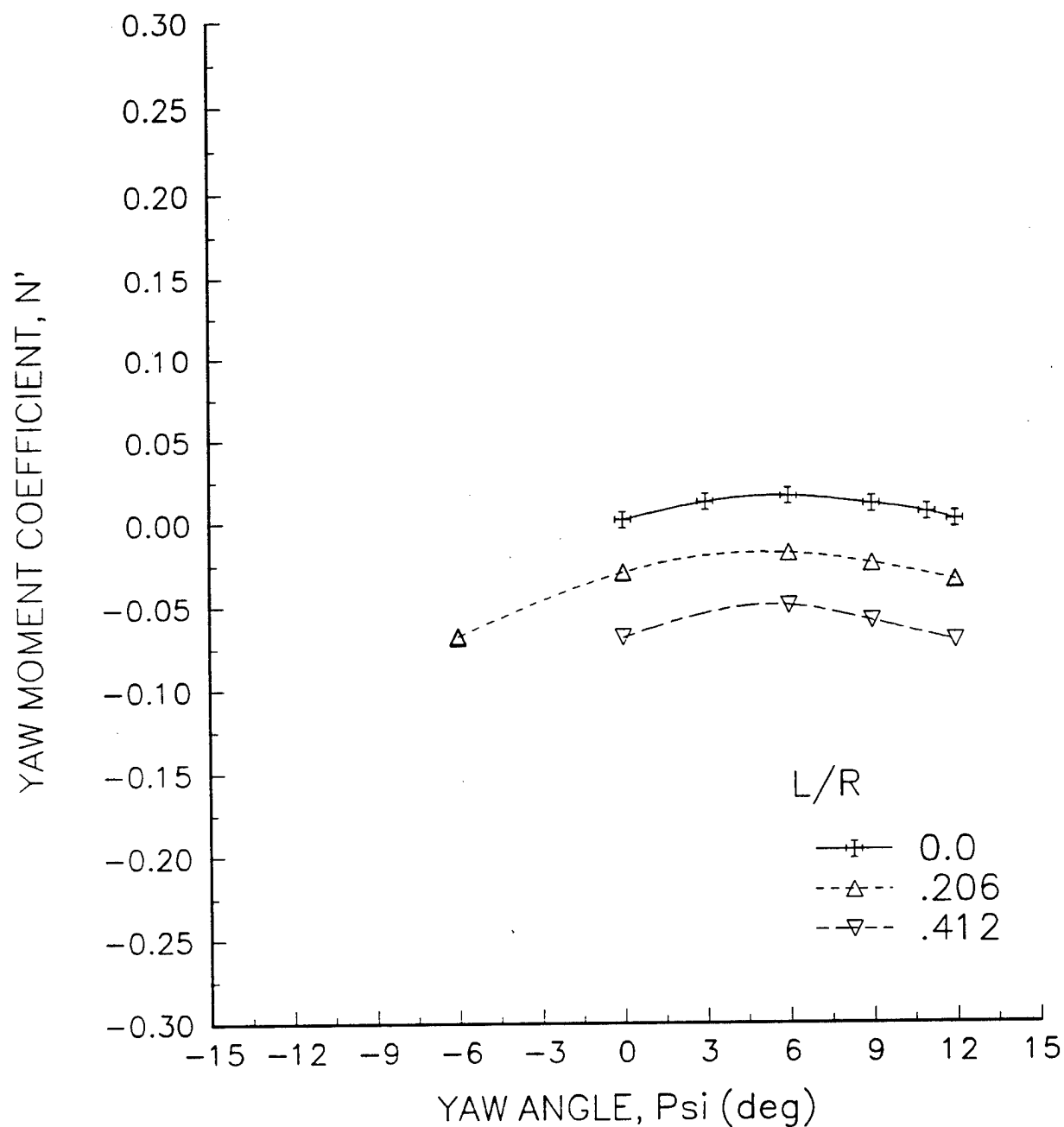


Figure D-89. N' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 0 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN
 Displacement 135 LTons
 ROLL ANGLE, Φ (deg) = 10, Speed = 35 Knots

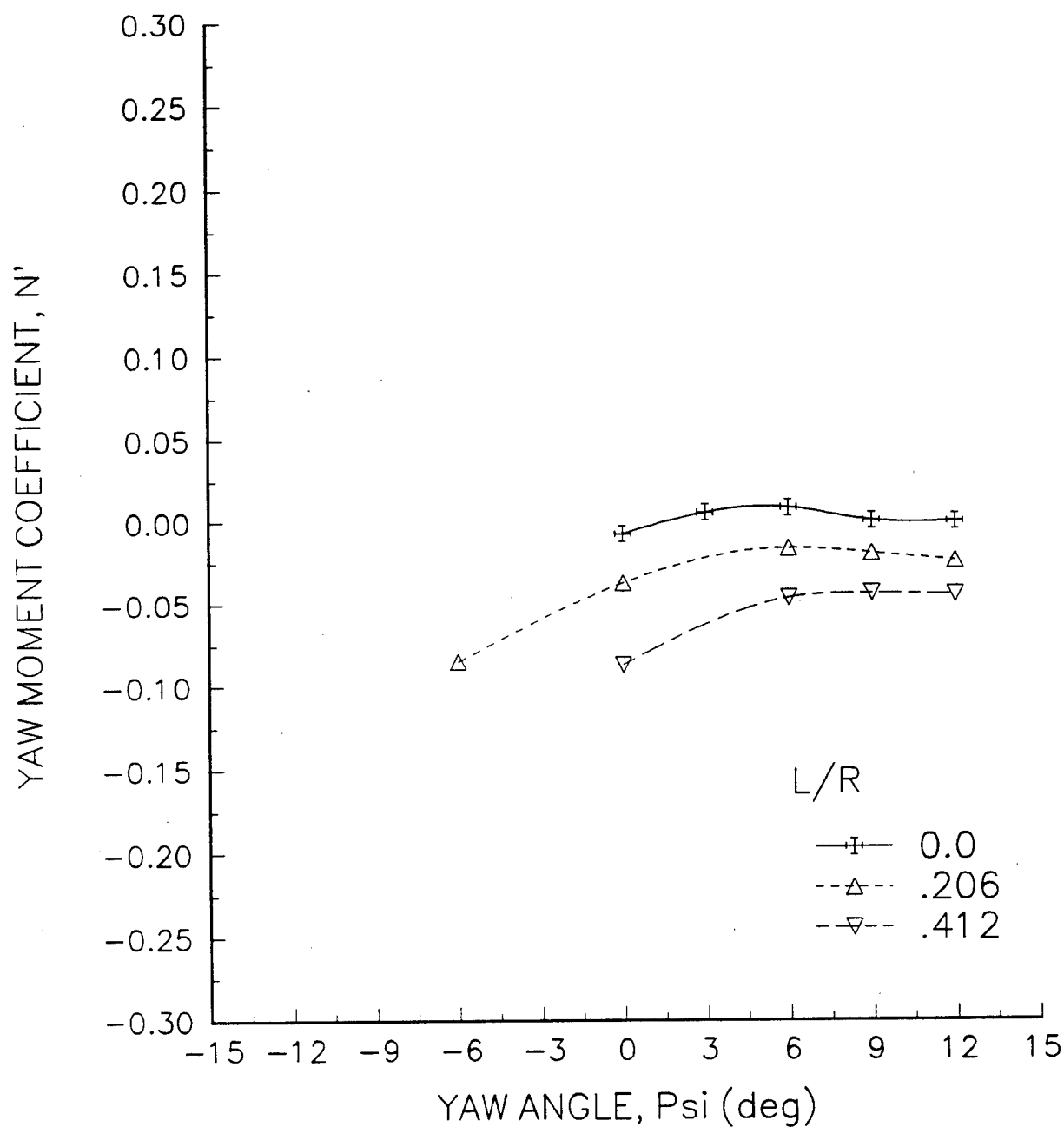


Figure D-90. N' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 10 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN
 Displacement 135 LTons
 ROLL ANGLE, Φ (deg) = 20, Speed = 35 Knots

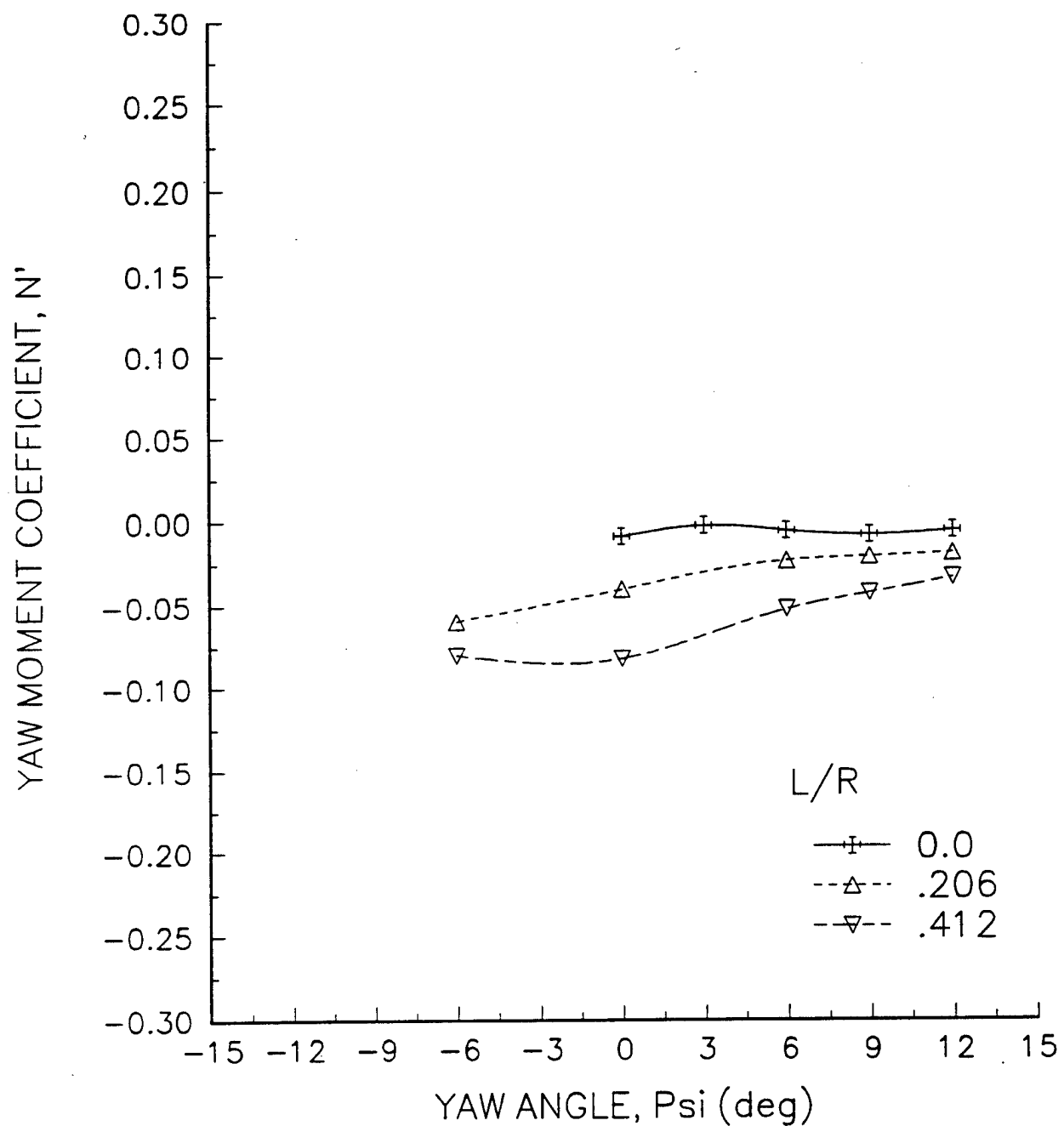


Figure D-91. N' versus Ψ with L/R as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Φ of 20 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Yaw Angle, Psi (deg) = -6, Speed = 35 Knots

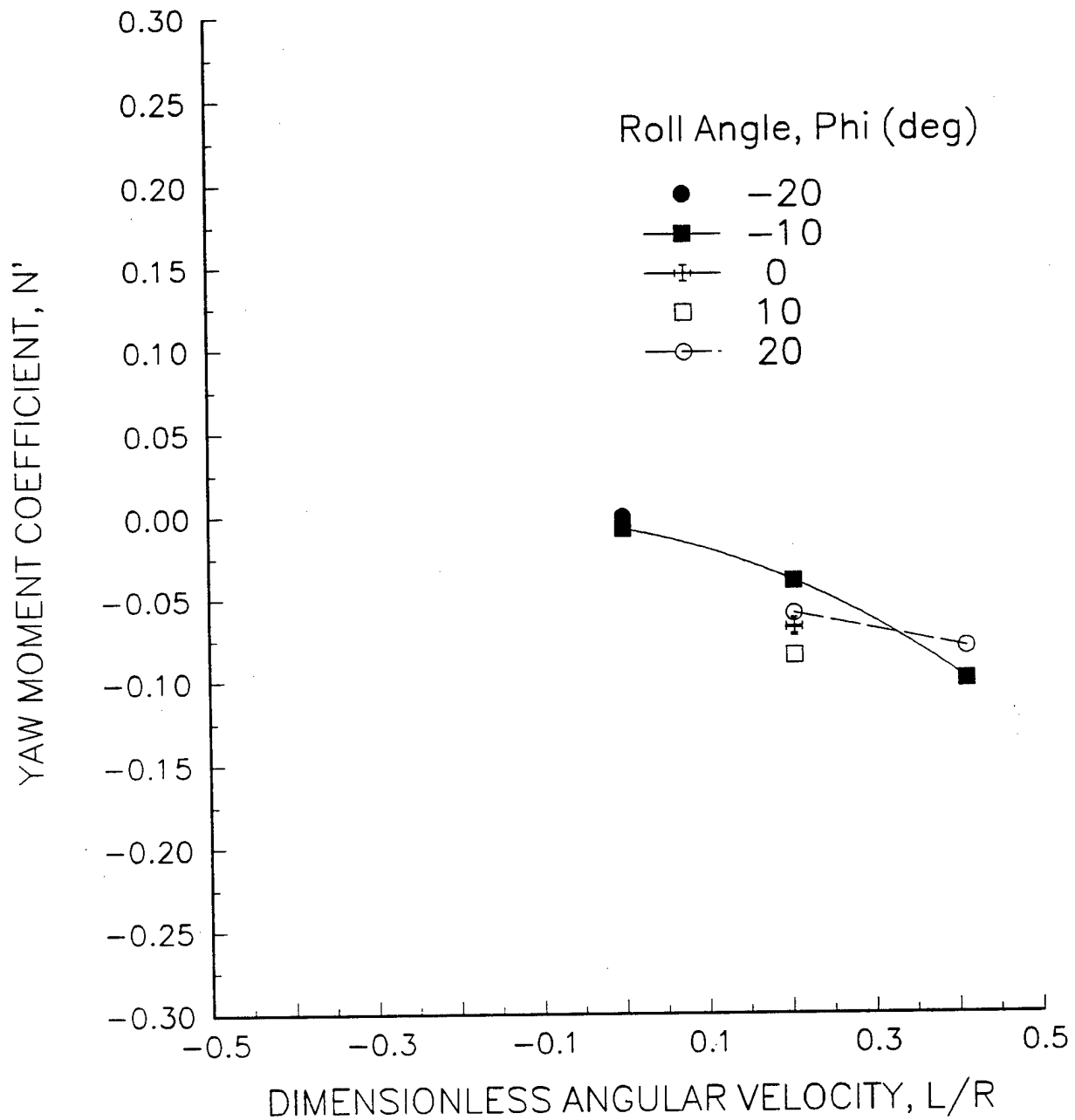


Figure D-92. N' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of -6 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Yaw Angle, Psi (deg) = 0, Speed = 35 Knots

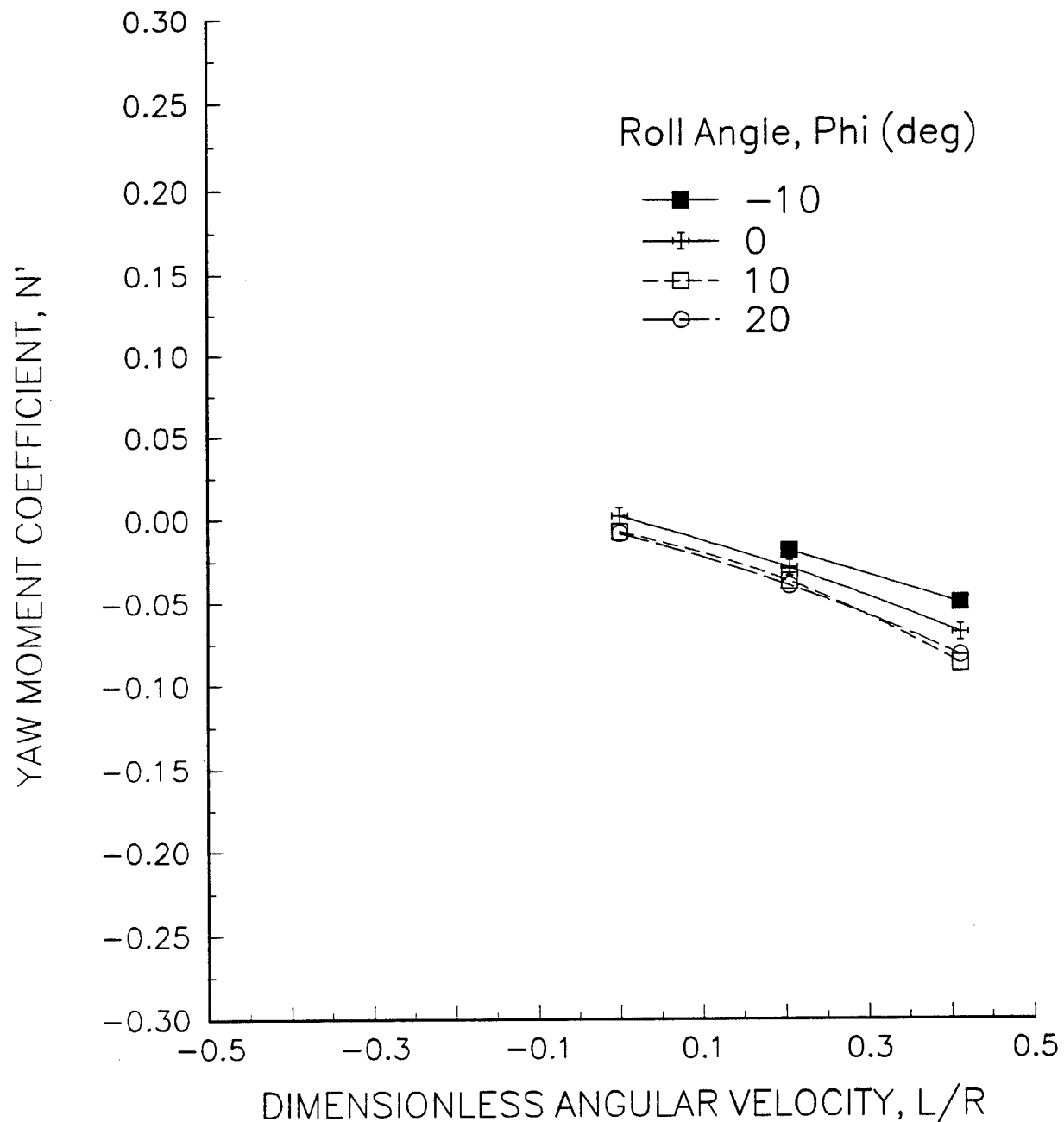


Figure D-93. N' versus L/R with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 0 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Yaw Angle, Psi (deg) = 6, Speed = 35 Knots

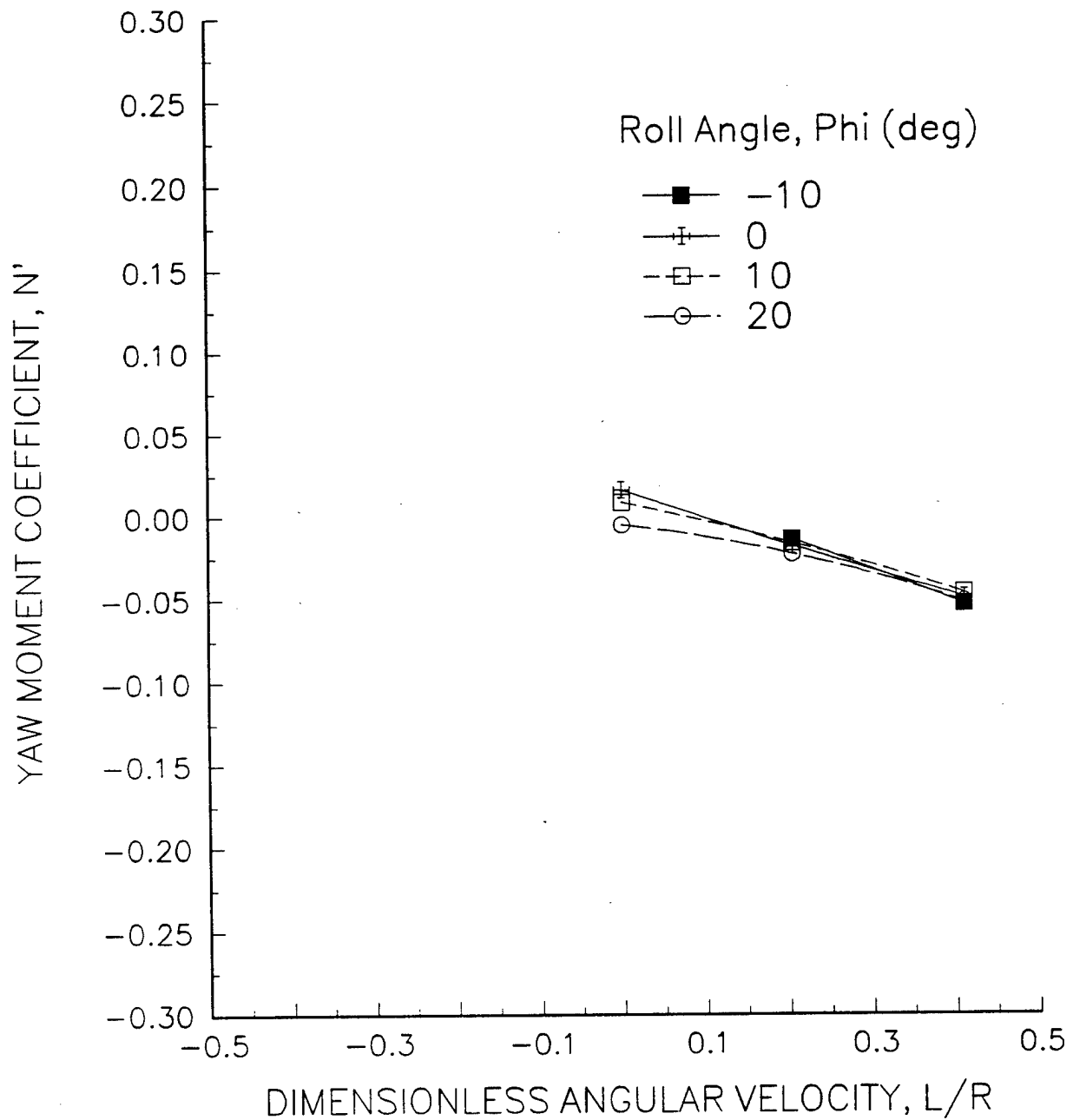


Figure D-94. N' versus L/R with Phi as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 6 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Yaw Angle, Psi (deg) = 9, Speed = 35 Knots

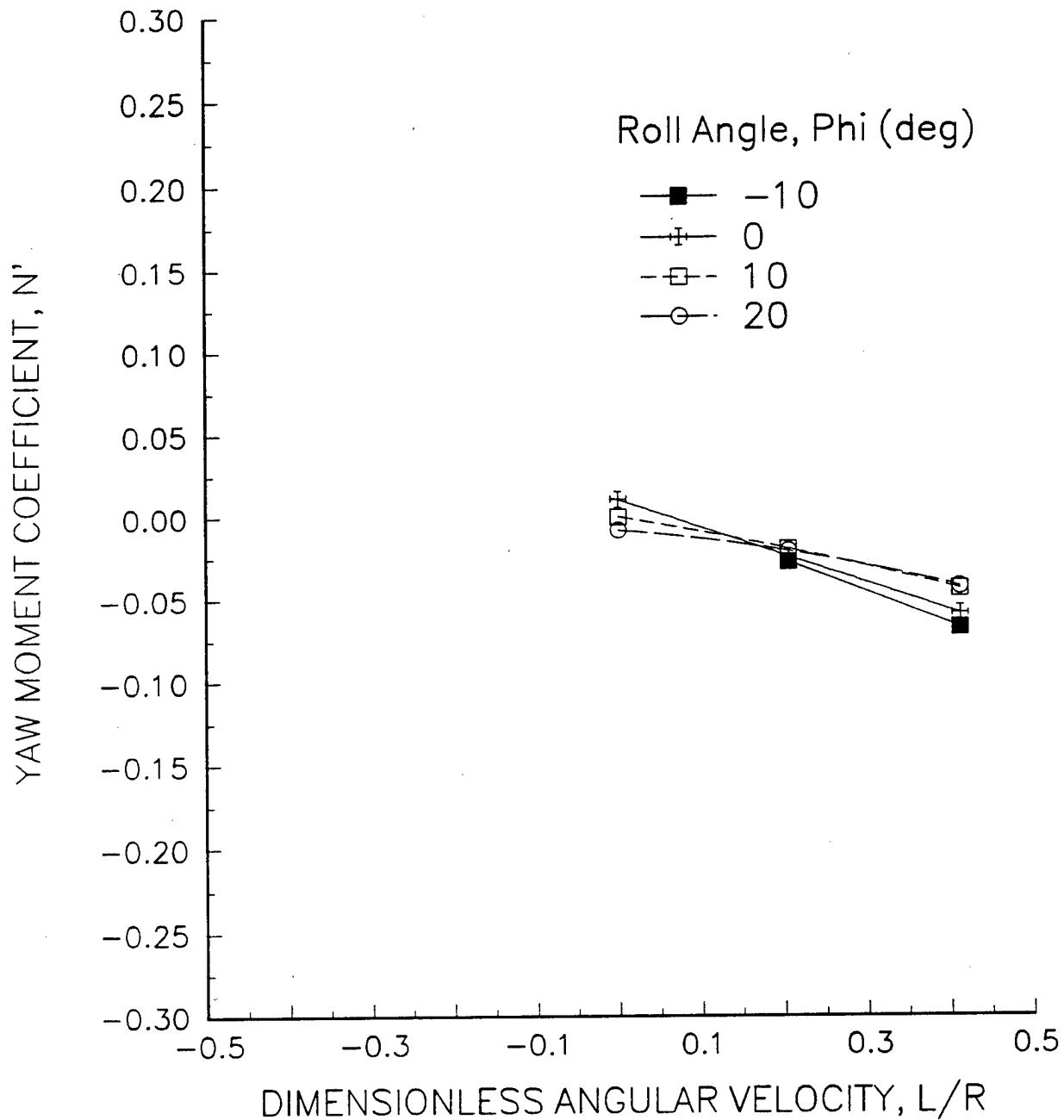


Figure D-95. N' versus L/R with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Psi of 9 degrees and a speed of 35 knots.

120 FT NOTIONAL WPB DESIGN

Displacement 135 LTons

Yaw Angle, Ψ (deg) = 12, Speed = 35 Knots

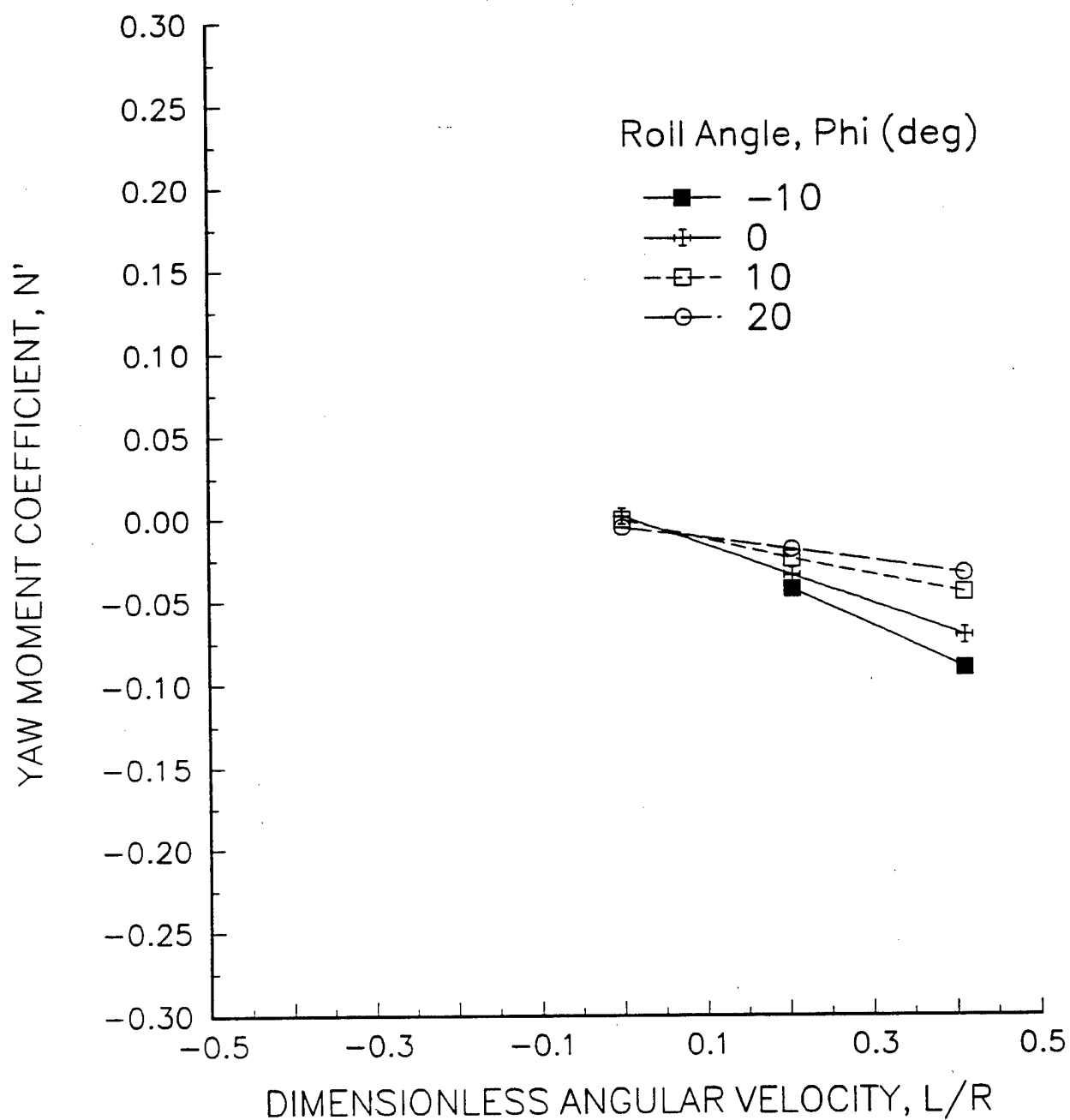


Figure D-96. N' versus L/R with Φ as a parameter, for a 135 L. Ton 120 Ft. WPB Notional Design at a Ψ of 12 degrees and a speed of 35 knots.